CALIFORNIA STATE MINING BUREAU

FERRY BUILDING, SAN FRANCISCO

FLETCHER HAMILTON — State Mineralogist

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CALIFORNIA MINERAL PRODUCTION FOR 1917

WITH COUNTY MAPS

By WALTER W. BRADLEY, Mining Statistician

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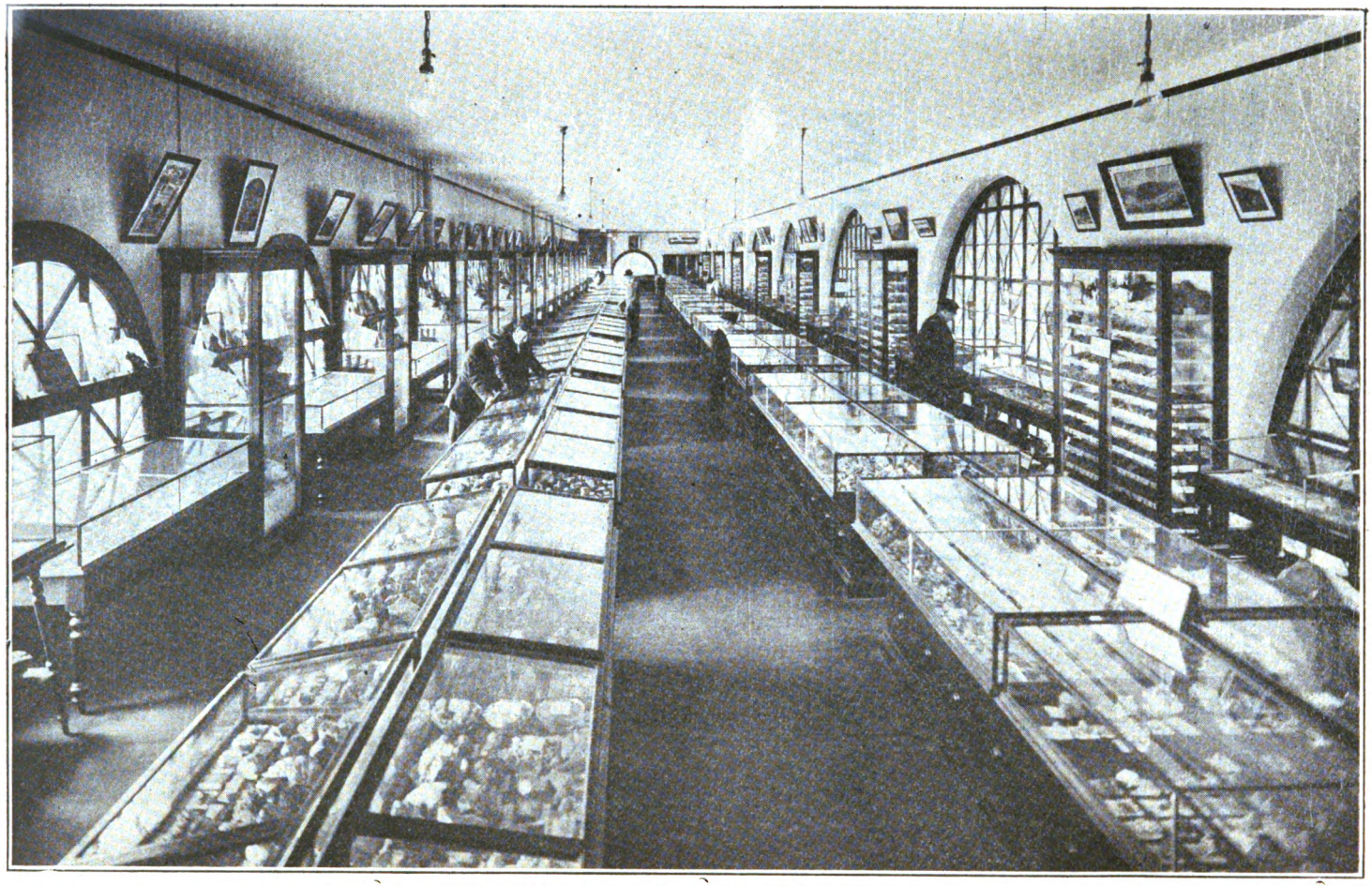

Museum of State Mining Bureau, Ferry Building, San Francisco, California.

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August, 1918

To His Excellency, the HONORABLE WILLIAM D. STEPHENS,
Governor of the State of California.

SIR: I have the honor to herewith transmit Bulletin No. 83 of the State Mining Bureau, being the annual report of the statistics of the mineral production of California.

The remarkable variety, total valuation, and wide distribution of many of our minerals revealed herein show California's continued strategic importance as a producer of commercial minerals among the states of the Union.

Respectfully submitted.

FLETCHER HAMILTON,
State Mineralogist.

LETTER OF INTRODUCTION.

It is the endeavor of the staff of the State Mining Bureau in these annual reports of the mineral industries of California to so compile the statistics of production that they will be of actual use to producers and to those interested in the utilization of the mineral products of our state, while at the same time keeping the individual's data confidential. In addition to the mere figures of output, we have included descriptions of the uses and characteristics of many of the materials, as well as a brief mention of their occurrences.

The compilation of accurate and dependable figures is an extremely difficult undertaking, and the State Mineralogist takes the opportunity of here expressing his appreciation of the co-operation of the producers in making this work possible. A fuller appreciation of the value of early responses to the requests sent out at the beginning of each year, will result in earlier publication of the data in the future.

Some of the data relative to properties and uses of many of the minerals herein described are repeated from preceding reports, as it is intended that this annual statistical bulletin shall be somewhat of a compendium of information on California's commercial minerals and their utilization.

FLETCHER HAMILTON,
State Mineralogist.

MINERAL INDUSTRY, CALIFORNIA, 1917.

DATA COMPILED FROM DIRECT RETURNS FROM PRODUCERS IN ANSWER TO INQUIRIES SENT OUT BY CALIFORNIA STATE MINING BUREAU, FERRY BUILDING, SAN FRANCISCO, CAL.

CHAPTER ONE.

Mineral output in California during the year 1917 amounted to the important sum of $161,202,962 worth of crude materials. There were fifty-four different mineral substances (a net gain of two), exclusive of a segregation of the various stones grouped under gems; and of the fifty-eight counties in the state, all but one contributed some mineral product.

As compared with the 1916 output, the notable features of 1917 are the continued increases along most of those lines which have been boosted by war conditions, the enormous increase in petroleum valuation, and the decrease of over a million dollars in the gold yield. The result is a net increase in the grand total value of $33,301,352 over the 1916 total, when for the first time in the history of California her total mineral yield for a year passed the one hundred million mark.

Of the metals: Copper decreased approximately 7,300,000 pounds in quantity and $479,069 in value. Gold decreased $1,323,237. Lead and quicksilver each increased, while silver, zinc and tungsten showed decreases.

Petroleum increased over five million barrels in quantity, and the prices per barrel for all grades continued to rise so materially that the net result was an increase of $29,554,875 in total value.

Decided gains are shown by some of the structural and industrial materials, such as cement, chromite, magnesite and manganese. Of these cement leads with a gain of over a million dollars, followed by magnesite with a gain of $664,334. All of the salines increased, but especially potash, from $663,605 to $4,202,889.

The figures of the State Mining Bureau are made up from reports received direct from the producers of the various minerals. Care is exercised in avoiding duplication, and any error is likely to be on the side of under- rather than over-estimation.

California yields commercially a greater number and variety of mineral products than any other state in the United States, and probably more than any other equal area elsewhere of the earth. Previous to 1916, the total annual value of her output was surpassed by but four

other states, they being the great coal and iron producers of east of the Mississippi River. In 1916 and 1917, because of their enormous increases in copper output, Montana and Arizona passed California in total value for those years. Of one item, at least, borax, California still remains the sole producer; and for many years, was also the sole domestic source of chromite and magnesite. We produce at least 75% of the quicksilver of the United States. For some years, we have been leading all others in gold and platinum; while alternating in the lead with Colorado in tungsten, and with Oklahoma in petroleum.

Motor trucks have proven invaluable in opening up mineral properties hitherto an unprofitable distance from railroad transportation. The advent and improvement of motor vehicles has induced the building of better roads everywhere, thus assisting very greatly in the development of many of our natural resources. The record of accomplishments given herein shows that California is certainly doing her part towards winning the war.

The following table shows the comparative yield of mineral substances of California for 1916 and 1917, as compiled from the returns received at the State Mining Bureau, San Francisco, in answer to inquiries sent to producers:

	1916		1917		Increase+ Decrease—
	Amount	Value	Amount	Value	Value
Antimony ore	1,015 tons	$64,793	158 tons	$18,786	$46,007—
Asbestos	145 tons	2,390	136 tons	10,225	7,845+
Barytes	1,606 tons	5,516	4,420 tons	25,633	20,117+
Bituminous rock	19,449 tons	66,561	5,590 tons	18,580	47,981—
Borax	103,523 tons	2,409,375	109,944 tons	2,561,958	152,583+
Brick and tile	206,960 M	2,096,570		2,532,721	436,151+
Cadmium			*	*	*
Cement	5,299,507 bbls.	6,210 293	5,790,734 bbls.	7,544,282	1,333,989+
Chromite	48,943 tons	717,244	52,379 tons	1,130,298	413,054+
Clay—pottery	134,636 tons	146,538	166,298 tons	154,602	8,064+
Coal	4 037 tons	7,030	3,527 tons	7,691	661+
Copper	55 809,019 lbs.	13,729,017	48,534,611 lbs.	13,249,948	479,069—
Dolomite	13,313 tons	46,566	27,911 tons	66,416	19,850+
Feldspar	2,630 tons	14,350	11,792 tons	46,411	32,061+
Fluorspar			*	*	*
Fuller's earth	110 tons	550	220 tons	2,180	1,630+
Gems		4,752		3,049	1,703—
Gold		21,410,741		20,087,504	1,323,237—
Granite		535,339		221,997	313,342—
Graphite	29,190 lbs.	*	*	*	*+
Gypsum	83,384 tons	59,533	30,825 tons	56,840	2,693—
Infusorial and diatomaceous earths	15,322 tons	80,649	24,301 tons	127,510	46 861+
Iron ore	3,000 tons	6,000	2,874 tons	11,496	5,496+
Lead	6,196 tons	855,049	10,823 tons	1,862,016	1,006,967+
Lime	493,675 bbls.	390,475	500,730 bb's.	311,380	79,095—
Limestone	187,521 tons	217,733	237,279 tons	356,396	138,663+
Lithia	71 tons	1,065	880 tons	8,800	7,735+
Magnesite	154,052 tons	1,311,893	209,648 tons	1,976,227	664,334+
Magnesium salts	851 tons	6,407	1,064 tons	34,973	28,566+
Manganese ore	13,404 tons	274,601	15,515 tons	396,659	122,058+
Marble	25.954 cu. ft.	50,280	24,755 cu. ft.	62,950	12,670+
Mineral paint	643 tons	3,960	520 tons	2,700	1,260—
Mineral water	2.273,817 ga's.	410.112	1.942,020 gals.	340,666	69,446—
Molybdenum ore	8 tons	9.945	243 tons	9,014	931—
Natural gas	28,134,365 M cu. ft.	2,871,751	44,343,020 M cu. ft.	2,964,922	93,171+
Petroleum	90,262,557 bbls.	57,421,334	95,396,309 bbls.	86,976,209	29,554,875+
Platinum	886 ounces	42,642	610 ounces	43,719	1,077+
Potash	17,903 tons	663,605	129,022 tons	4,202,889	3,539,284+
Pumice and volcanic ash	1,216 tons	18,092	525 tons	5,295	12,797—
Pyrite	120,525 tons	372,969	111,325 tons	323,704	49,265—
Quicksilver	21,427 flasks	2,003,425	24,382 flasks	2,396,466	393,041+
Salt	186,148 tons	455,695	227,825 tons	584,373	128,678+
Sandstone	17,270 cu. ft.	10,271	31,090 cu. ft.	7,074	3,197—
Serpentine			*	*	*
Silica (sand and quartz)	20,880 tons	48,908	19,376 tons	41,166	7,742—
Silver		1,687,345		1,462,955	224,390—
Soapstone and talc	1,703 tons	9,831	5,267 tons	45,279	35,448+
Soda	10,593 tons	264,825	24,505 tons	928,578	663,753+
Miscellaneous stone†		4,171,519		3,634,767	536,752—
Strontium	57 tons	2,850	3,050 tons	37,000	34,150+
Tungsten concentrates	2,270 tons	4,571,521	2,466 tons	3,079,013	1,492,508—
Zinc	15,950,565 lbs.	2,137,375	11,854,804 lbs.	1,209,190	928,185—
Unapportioned*		2,335		20,455	18,120+
Totals		$127,901,610		$161,202,962	
Net increase					$33,301,352

*Unapportioned—includes cadmium, fluorspar, graphite and serpentine.

†Includes macadam, ballast, rubble, rip-rap, paving blocks, sand, gravel, and grinding mill pebbles.

The following table shows the comparative value of the mineral production of the various counties in the state for the years 1916 and 1917:

County	1916	1917
Alameda	$1,094,167	$1,138,723
Alpine		
Amador	3,811,428	3,851,194
Butte	1,356,925	1,130,259
Calaveras	2,965,592	3,717,150
Colusa	42,803	16,321
Contra Costa	1,279,060	1,276,657
Del Norte	2,432	104,340
El Dorado	470,687	313,602
Fresno	8,061,193	14,158,052
Glenn	81,162	65,272
Humboldt	274,895	59,858
Imperial	105,333	129,400
Inyo	4,600,096	6,296,230
Kern	37,826,907	49,743,422
Kings	26,788	2,777
Lake	180,996	170,552
Lassen	9,725	376
Los Angeles	4,463,045	8,204,523
Madera	222,758	236,937
Marin	178,306	272,302
Mariposa	487,971	352,227
Mendocino	55,680	50,415
Merced	81,530	147,116
Modoc	3,559	200
Mono	240,990	218,772
Monterey	109,872	138,786
Napa	1,078,537	1,421,073
Nevada	3,744,143	3,838,397
Orange	8,905,086	15,231,626
Placer	1,042,629	1,029,789
Plumas	1,399,335	2,294,886
Riverside	1,234,252	1,580,555
Sacramento	2,178,674	2,286,656
San Benito	1,213,447	1,233,163
San Bernardino	6,569,147	7,407,742
San Diego	397,168	1,713,708
San Francisco	76,437	107,957
San Joaquin	468,862	470,220
San Luis Obispo	245,807	338,144
San Mateo	135,408	207,163
Santa Barbara	4,535,029	5,153,081
Santa Clara	851,948	991,530
Santa Cruz	1,679,111	1,668,324
Shasta	13,639,508	10,244,869
Sierra	729,497	389,615
Siskiyou	580,896	829,409
Solano	1,205,335	1,899,231
Sonoma	472,048	506,750
Stanislaus	253,022	289,922
Sutter	6,450	5,000
Tehama	54,353	44,019
Trinity	846,561	987,842
Tulare	947,200	1,499,988
Tuolumne	1,004,262	511,273
Ventura	1,135,430	1,498,010
Yolo	300	5,561
Yuba	3,237,828	3,721,996
Totals	$127,901,610	$161,202,962

CHAPTER TWO.

FUELS.

Among the most important mineral products of California are its fuels. This subdivision includes coal, natural gas and petroleum, the combined values of which make up over 50 per cent of the state's entire mineral output. Comparison of values during 1916 and 1917 is shown in the following table:

	1916		1917		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Coal	4,037 tons	$7,030	3,527 tons	$7,691	$361+
Natural gas	28,134,365 M. cu. ft.	2,871,751	44,343,020 M. cu. ft.	2,964,922	93,171+
Petroleum	90,232,557 bbls.	57,421,334	95,396,309 bbls.	86,976,209	29,554,875+
Tota's		$60,300,115		$89,948,822	
Net increase					$29,648,707+

COAL.

Bibliography: State Mineralogist Reports VII, XII, XIII, XIV, XV. U. S. G. S., Bulletins 285, 316, 431, 471, 581; An. Rep. 22, Pt. III.

Coal has been produced in California since as early as 1860, and until the development of crude oil was an important factor in the mineral industry of the state. As most of it is lignite, the quality is generally poor as compared with other coals on the Pacific Coast markets. However, in competition with fuel oil, coal of all grades has had to take second place. Besides the counties noted below as showing a commercial production, workable bodies of coal are also known in several others, including Alameda, Mendocino, Monterey, Shasta, Siskiyou and Riverside.

During 1917, there was a production reported from Amador and Contra Costa counties, totaling 3,527 tons, worth $7,691.

Though no exact figures of output previous to 1887 are available, it is known that many hundred thousand tons were shipped from the

Mount Diablo district, Contra Costa County, between the years 1860 and 1887. Since 1887, the annual output of coal has been as follows:

Year	Tons	Value	Year	Tons	Value
1887	50,000	$150,000	1904	79,062	$376,494
1888	95,000	380,000	1905	46,500	144,500
1889	121,280	288,232	1906	24,850	61,600
1890	110,711	283,019	1907	23,734	55,849
1891	93,301	204,902	1908	18,496	55,503
1892	85,178	209,711	1909	49,389	216,913
1893	72,603	167,555	1910	11,033	23,484
1894	59,887	139,862	1911	11,047	18,297
1895	79,858	193,790	1912	14,484	39,092
1896	70,649	161,335	1913	25,198	85,809
1897	87,449	196,255	1914	11,859	28,806
1898	143,045	337,475	1915	10,299	26,662
1899	160,941	420,109	1916	4,037	7,030
1900	176,956	535,531	1917	3,527	7,691
1901	150,724	401,772			
1902	88,460	248,622	Totals	2,072,583	$5,731,283
1903	93,026	265,383			

NATURAL GAS.

Bibliography: State Mineralogist Reports VII, X, XII, XIII, XIV. Bulletins 3, 16, 19, 69, 73.

Statistics on the production of natural gas in California have been largely guesswork in the past, though each year becoming less so, as more data are available. The figures here given are certainly far below the actual production, particularly in the six oil-producing counties. It is an exceptional oil property where gas in some quantity does not occur. Many oil-producing concerns make no mention of their gas, because they have no method of measuring it, but it is widely used in the oil fields. Doubtless, considerable gas is wasted, but a sweeping condemnation of operators should not be indulged in. It must be remembered that several of our important oil fields are removed many miles from the site of any other industry, and that the gathering of small amounts of gas and transporting it for any considerable distance may not always be profitable. However, it is undoubtedly a fact that greater saving can frequently be made with profit. Gas traps of various size and design are coming into more frequent use. Some large operators are making commendable efforts to conserve the gas which accompanies oil and is richer than the so-called 'dry gas' occurring in strata which do not produce oil. As far as possible, casing-head gas is used in driving gas engines for pumping and drilling, and in firing the boilers of steam-driven plants.

In a hearing before the California Railroad Commission, in May, 1916, relative to gas rates in the Los Angeles territory, part of the testimony showed in the Midway field 46,600,000 cubic feet of natural gas available per 24 hours. This is made up of 28,750,000 feet from

the dry gas wells and 17,850,000 feet from wells producing both gas and oil. It was estimated that this supply would have a life of from seven to ten years. The Midway pipe line is capable of transmitting 23,000,000 cubic feet per day.

It will be noted that several counties produce gas which is not accompanied by oil particularly Sacramento and San Joaquin, where it is mixed with manufactured gas for domestic service.

The value of gas as here shown may be open to some question, but is certainly not too high, as regards the oil counties. The average price is about 6¢ per 1,000 cubic feet. Approximately 7,000 cu. ft. of gas is equal to one barrel of oil in heating value, and is so accounted for by many operators. In driving gas engines, about 4,000 cu. ft. per 24 hr. are consumed by a 25 h.p. engine, and 63,700 cu. ft. per day for heating a 70 h.p. steam boiler, which figures have been used in compiling this report.

Natural Gas, 1917.

	M cubic feet	Value
Fresno	4,097,626	$347,501
Kern	25,819,376	1,445,880
Kings	3,569	2,777
Los Angeles	1,670,476	194,793
Orange	8,171,835	490,511
San Joaquin	348,146	72,585
Santa Barbara	3,104,170	227,507
Ventura	1,033,564	152,550
Butte, Humboldt, Lake, Sacramento, and Solano*	94,258	30,818
Totals	44,343,020	$2,964,922

*Combined to conceal output of an individual producer in each

The annual production of natural gas in California since 1888 is as follows:

Year	Value	Year	Value
1888	$10,000	1904	$91,035
1889	12,680	1905	102,479
1890	33,000	1906	109,489
1891	30,000	1907	114,759
1892	55,000	1908	474,584
1893	68,500	1909	616,932
1894	79,072	1910	1,676,367
1895	112,000	1911	491,859
1896	111,457	1912	940,076
1897	62,657	1913	1,053,292
1898	74,424	1914	1,049,470
1899	95,000	1915	1,706,480
1900	34,578	1916	2,871,751
1901	92,034	1917	2,964,922
1902	99,443		
1903	74,237	Total	$15,307,577

Gasoline from Natural Gas.

As above indicated, more or less gas usually accompanies the petroleum in the oil fields. A number of plants are in operation manufacturing gasoline by compression from this 'casing-head gas.' This subject was investigated by the U. S. Bureau of Mines and the U. S. Geological Survey, and described in considerable detail by G. A. Burrell et al.,[1] and J. D. Northrup.[2] A valuable article also appeared in one of the trade journals.[3] The Department of Petroleum and Gas, of the State Mining Bureau, intends to conduct a detailed investigation of natural gas production with the idea of being able to point out means of more economical use of this splendid natural resource.

The largest natural gas field of commercial importance thus far developed in California is in the Midway district, followed by Santa Barbara, Orange and Los Angeles counties, in the order named. The Southern California Gas Company operates a 12-inch pipe line from the Midway field, a distance of 107 miles, to Los Angeles, where it supplies gas to local distributing companies. The Valley Natural Gas Company supplies gas to consumers in the Midway field and to local distributing companies at Fellows, Taft, Maricopa, Bakersfield, and the Kern River fields. The Santa Maria Gas and Power Company distributes gas around Santa Maria, from wells in the neighboring oil fields.

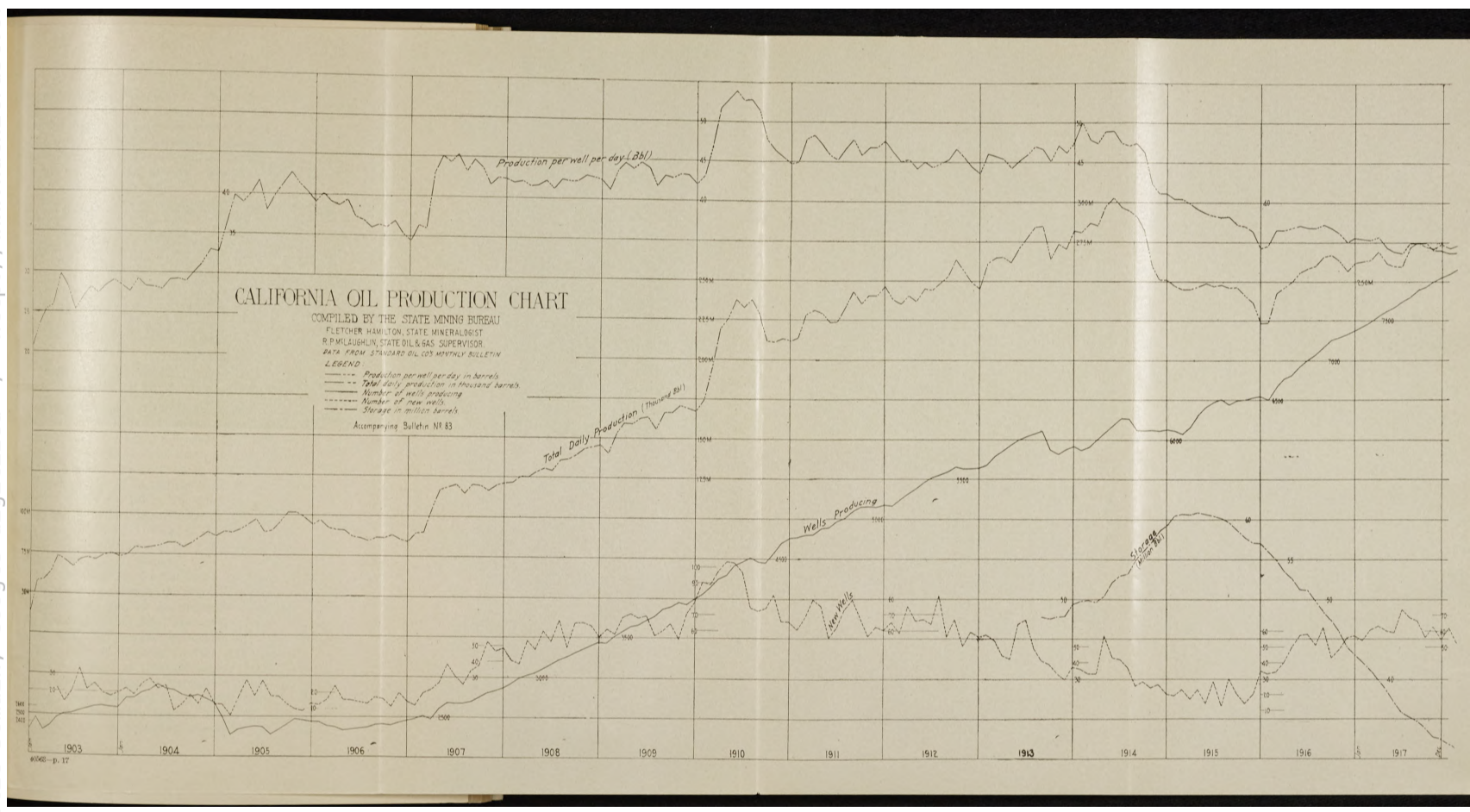
There are in operation a total of 31 plants making casing-head gasoline by compression, with a total daily capacity estimated at 61,400 gallons, distributed as follows:

Field	Number plants	Gallons daily
Coalinga	1	2,000
Whittier-Fullerton	9	15,850
Midway	8	16,700
Santa Maria	7	19,900
Salt Lake (Los Angeles)	3	3,600
Ventura	3	3,350
Totals	31	61,400

At Santa Maria, after the gasoline is extracted, the remaining 'dry gas' is taken into the pipe lines of the Santa Maria Gas and Power Company, by whom it is distributed to consumers, both domestic and commercial.

In the Midway field, some of the casing-head gasoline is obtained as an incidental product to the compressing of the natural gas preliminary to transmission through the gas pipe lines. Some concerns market

[1] U. S. Bur. of Mines, Bull. 88.
[2] U. S. G. S., Min. Res. 1914, Pt. II. pp. 793–795; 798–800; 804–805.
[3] Oil & Gas Journal, Tulsa, Okla., Jan. 13, 1916, p. 62.



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casing-head gasoline separately, while others turn it into the oil pipe lines, thus mixing this high-gravity gasoline with the crude oil for transportation to the refinery, where it is later regained. A total of approximately 21,953,447 gallons of casing-head gasoline from all fields was made during 1917 and utilized directly as such. Santa Barbara County led in this output with a total of 9,063,009 gallons, Kern being second with 8,339,925 gallons.

[4]"There are many peculiarities in connection with the extraction of gasoline from gas that are ascertained only through the closest study. The percentage of gasoline taken from the highest grades of oil, it is natural to infer, is much greater than that taken from low grades of oil, and yet this does not always prove to be the case. Much depends upon the amount of oil produced with the relative amount of gas coming with the oil. For instance, if an oil well is a small producer of oil and a heavy gasser, the percentage of gasoline is much larger than it would be from the same amount of gas coming from a large production of oil. Old wells seem to be more prolific in gasoline than new wells.

"Aside from the Salt Lake field, only a small percentage of the gas coming from low-grade oil has proved to be of commercial value. This is especially true among new producing wells where the oil is of a gravity below 18 degrees.

"It is stated that as a general average gas coming from grades of oil of from 22°–25°, will make from four to six quarts to the thousand feet of gas; from 25°–29° it will average from two to three gallons per thousand feet, and above 29° it will average from three to five gallons per thousand feet.

"The richest gas so far discovered in the state is that found in the old Newhall field. The wells are all very old and small producers of high-gravity oil."

PETROLEUM.

Bibliography: State Mineralogist Reports IV, VII, X, XII, XIII. Bulletins 3, 11, 16, 19, 31, 32, 63, 69, 73, 82.

Chief of the fuels of California is petroleum. A complete description of the industry is to be found in Bulletin 69, issued in 1915 by the State Mining Bureau; supplemented by Bulletins 73 and 82, annual reports of the Oil and Gas Supervisor for the fiscal years 1915–1916, and 1916–1917. The state law providing for the regulation of drilling and maintenance of oil and gas wells by the State Mining Bureau has been in effect since 1915. The chief aim is to protect the oil deposits from damage and to aid producers in their work. A staff of technically trained men maintain offices in the various fields. California is certainly not exceeded by any other state in its efforts to accurately keep in touch with the oil business.

The oil production for California for 1917, as determined from the sworn statements made to the State Mineralogist for the Department of Petroleum and Gas, by the producers from 7,834 wells (exclusive of the Los Angeles City field) amounted to 94,433,547 barrels net. 'Net' means that a deduction of approximately 2% has been made for water. A part of the oil consumed for fuel at the wells is not included. This shows an increase of 7,370,352 barrels from the net figures for 1916. When the same deductions for water and fuel have been made from the figures already published by the Standard Oil Company and the Independent Oil Producers Agency, it will be seen that they are in fair agreement with the 94,433,547 barrels above recorded.

[4]O & G. Journal, *loc. cit.*

To the above amount, we have here added 677,441 barrels consumed for fuel at the wells, not included above, and 285,321 barrels net output of the Los Angeles City fields, making a total gross output for the year 1917 of 95,396,309 barrels valued at $86,976,209. As compared to 1916 this is an increase of 5,133,752 barrels in quantity, and of $29,554,875 in value. This great jump in value is due to the fact that the average price per barrel for all fields and all grades increased from 63.6¢ in 1916 to 90.8¢ in 1917. The total or average figures on price may be open to some question, as it must be remembered that a large portion of the crude oil does not enter the open market, but is consumed or refined directly by the producers. The prices given are for oil which is actually sold, and are known to be accurate.

Kern was the only county to show a decrease in the quantity for 1917 as compared to 1916. Several causes contributed to the decline. The two prominent ones are: the continued tying up by Federal suits and withdrawals of the one district of the state which promises the most for future development, namely, the Midway-Sunset; and the fact that in nearly all the fields there is a decline in the number of barrels per well per day yield. The increase in production for the state as a whole was brought about by marked drilling activity. The new Montebello field production in Los Angeles County was the outstanding feature of 1917.

Production and Value of Oil by Counties.

County	1916		1917	
	Barrels	Value	Barrels	Value
Fresno	14,594,246	$7,530,631	16,259,797	$13,414,333
Kern	54,120,509	24,691,246	53,065,066	47,387,104
Los Angeles	2,875,468	1,871,930	4,669,583	5,491,430
Orange	13,198,591	8,750,666	14,680,801	14,724,843
San Luis Obispo	11,670	5,252	74,113	68,656
Santa Barbara	4,502,206	3,574,752	5,631,563	4,550,303
Santa Clara	16,368	10,901	18,855	26,152
Ventura	943,499	985,956	996,501	1,313,388
Totals	90,262,557	$57,421,334	95,396,309	$86,976,209

Average Price of Oil, by Counties, in Cents per Barrel.

County	1914	1915	1916	1917
Fresno	15.2¢	54.5¢	51.6¢	82.5¢
Kern	10.9¢	42.3¢	64.1¢	89.3¢
Los Angeles	55.0¢	62.9¢	65.1¢	117.6¢
Orange	67.5¢	51.2¢	66.3¢	100.3¢
San Luis Obispo			45.0¢	92.6¢
Santa Barbara	46.0¢	61.1¢	79.4¢	80.8¢
Santa Clara	53.0¢	66.6¢	66.6¢	138.7¢
Ventura	105.0¢	85.5¢	104.5¢	131.8¢
State average	46.1¢	47.9¢	63.6¢	90.8¢

The annual production since discovery in 1875 is as follows:

Year	Barrels	Year	Barrels
1875	175,000	1898	2,249,088
1876	12,000	1899	2,677,875
1877	13,000	1900	4,319,950
1878	15,227	1901	7,710,315
1879	19,858	1902	14,356,910
1880	40,552	1903	24,340,839
1881	99,862	1904	29,736,003
1882	128,636	1905	34,275,701
1883	142,857	1906	32,624,000
1884	262,000	1907	40,311,171
1885	325,000	1908	48,306,910
1886	377,145	1909	58,191,723
1887	678,572	1910	77,697,568
1888	690,333	1911	84,648,157
1889	303,220	1912	89,689,250
1890	307,360	1913	98,494,532
1891	323,600	1914	102,881,907
1892	385,049	1915	91,146,620
1893	470,179	1916	90,262,557
1894	783,078	1917	95,396,309
1895	1,245,339		
1896	1,257,780	Total	1,039,284,601
1897	1,911,569		

The total value since 1887 is as follows:

Year	Value
1887–1909	$136,693,228
1910	37,689,542
1911	40,552,088
1912	41,868,344
1913	48,578,014
1914	47,487,109
1915	43,503,837
1916	57,421,334
1917	86,976,209
Total	$540,769,708

Production by Fields.*
(In Barrels of 42 Gallons.)

Field	1916	1917
Kern River	8,402,525	8,495,610
McKittrick	3,230,644	3,252,544
Midway-Sunset	38,925,476	36,560,145
Lost Hills-Belridge	4,852,431	6,295,329
Coalinga	14,381,493	15,938,543
Lompoc and Santa Maria	4,422,410	5,798,070
Ventura County and Newhall	1,122,033	1,186,407
Los Angeles and Salt Lake	1,721,453	1,501,799
Whittier-Fullerton	14,679,672	18,155,440
Summerland	56,775	56,570
Watsonville	27,450	27,375
Totals	91,822,362	97,267,832
Net increase	5,445,470	

*Standard Oil Bulletin, January, 1918.

The following table is compiled from the monthly statements of the statistical bureau of the Independent Oil Producers Agency and given in their summary issued January 19, 1918:

Well Operations, by Months, 1917.

	Wells completed	Estimated daily average production	Wells drilling	New rigs	Wells producing	Wells abandoned
January	57	6,150	312	80	6,956	7
February	55	6,655	326	76	7,035	17
March	62	8,530	364	102	7,168	4
April	68	11,380	342	45	7,215	16
May	68	7,145	355	65	7,307	14
June	59	7,880	376	55	7,352	12
July	63	15,195	381	65	7,476	6
August	62	22,755	384	61	7,586	29
September	76	12,595	372	63	7,602	15
October	67	15,135	362	51	7,638	10
November	60	7,630	381	69	7,694	16
December	50	7,190	382	43	7,742	16
Average, 1917	63	10,690	361	65	7,398	14
Average, 1916	52	8,647	238	56	6,542	18

The following table is compiled from the monthly statements contained in the Standard Oil Bulletin:

Well Operations, by Fields, 1917.

Field	Producing December, 1916	Producing December, 1917	Completed	Abandoned
Kern River	1,908	1,969	40	3
McKittrick	293	309	26	1
Midway-Sunset	1,710	1,997	282	19
Lost Hills-Belridge	350	485	132	4
Coalinga	949	1,038	114	29
Santa Maria-Lompoc	249	300	63	5
Ventura County and Newhall	446	451	22	9
Los Angeles and Salt Lake	674	683	1	10
Whittier-Fullerton	637	704	56	11
Summerland	112	112	----------	----------
Watsonville	5	5	----------	----------
Totals	7,333	8,053	736	91

The proportion of heavy and light oil produced in the various fields is shown by the following figures, for which we are indebted to the Standard Oil Company. Oil below 18° Baumé may be considered as largely unrefinable, or fuel oil; while the lighter oils yield varying amounts of refined products and a very large proportion of residuum and fuel oil. A few years ago, the total amount of heavy oil was in excess of the light oil.

Production of Light and Heavy Oil, by Fields, 1917.

Field	Under 18° (barrels)	18° and over (barrels)	Total (barrels)
Kern River	8,495,610	----------	8,495,610
McKittrick	3,252,544	----------	3,252,544
Midway-Sunset	10,192,405	26,367,740	36,560,145
Lost Hills-Belridge	1,478,867	4,816,462	6,295,329
Coalinga	5,693,557	10,244,986	15,938,543
Santa Maria-Lompoc	2,052,280	3,745,790	5,798,070
Ventura County and Newhall	125,664	1,060,743	1,186,407
Los Angeles and Salt Lake	1,204,386	297,413	1,501,799
Whittier-Fullerton	250,247	17,905,193	18,155,440
Summerland	56,570	----------	56,570
Watsonville	----------	27,375	27,375
Totals	32,802,130	64,465,702	97,267,832

Financial Results.

Financial results of the oil business during 1917, are shown by the following tables. The outstanding features are: 1. the substantial increase of prices for all grades over the 1916 figures; 2. a decrease in nearly all fields in the number of barrels per well per day yield; 3. an increase in operating costs per barrel, resulting in raising the cost per

well per day. Because of the bringing in of a number of gusher wells in the Montebello field, the figures for the Los Angeles-Orange group show an increase in the barrels per well per day yield, and a consequent decrease in the cost of operations per barrel in spite of the higher costs of labor and materials prevailing. The profitable, or dividend-paying companies received a slightly higher figure for their product than the average market price, probably due to the higher grade of oil produced by them. It is also noticeable that their production cost per barrel is usually lower than the average, due to the fact that their wells are more productive. Operating cost per well is not always lower for the dividend companies than others. Profitable operations seem to depend generally upon large wells, high-grade oil, and proximity to market. There is nothing to indicate that unnatural causes or manipulations have affected the profits of one producer against another. It may be noted that both price and profits are greater in the Los Angeles-Orange-Ventura fields than in others, doubtless largely due to the proximity to market and higher grades of oil.

In addition to consuming the current production of crude oil, the storage was drawn upon at an average rate of nearly 1,000,000 barrels per month during 1917. According to the Standard Oil Company,[5] the stocks on hand on December 31, 1917, amounted to 32,450,465 barrels, a decrease of 11,585,725 barrels from the 44,036,190 barrels on hand December 31, 1916. The monthly bulletins of the Independent Oil Producers Agency show practically the same results—32,656,996 barrels, being a decrease of 10,983,298 barrels.

FINANCIAL AND OPERATING CONDITION OF CALIFORNIA OIL FIELDS, 1917.

Capitalization.

Field	Number of companies considered	Per cent of total product of field	Capital	
			Cash	Property
Coalinga	41	29	$4,529,741	$23,351,800
Kern River	49	38	5,548,934	4,757,038
Midway	73	43	5,221,762	45,087,263
Sunset	25		2,588,477	6,049,340
McKittrick, Lost Hills, Belridge	21	51	1,631,249	3,037,868
Santa Barbara County	12	27	2,348,383	4,289,080
Ventura County	20	64	1,045,921	2,473,894
Los Angeles and Orange Counties	30	17	4,388,934	7,153,824
Subtotals	271		$27,303,401	$96,129,607
Miscellaneous and marketing companies	19	16	58,670,078	110,211,509
Totals	294		$85,973,479	$206,341,116

[5]Standard Oil Bulletin, January, 1918.

Dividends Paid by Oil Companies, 1912-1917.

Field	1912		1913		1914		1915		1916		1917	
	Companies	Value	Companies	Value	Companies	Value	Companies	Value	Companies	Value	Companies	Value
Coalinga	15	$1,154,328	17	$956,098	15	$1,048,840	13	$283,660	12	$217,949	20	$712,331
Kern River	26	454,095	19	361,414	20	205,258	20	187,962	23	405,556	22	306,508
Midway	19	1,128,161	14	520,520	25	917,981	23	853,376	29	1,207,974	34	1,938,769
Sunset	7	319,220	3	91,936	5	166,152	7	149,932	5	241,200	14	682,644
McKittrick, Belridge and Lost Hills	2	134,945	6	538,744	8	493,339	7	397,827	7	434,184	14	837,129
Santa Barbara County	6	374,720	8	500,976	6	480,534	6	317,727	7	293,025	6	923,228
Ventura County	2	26,393	2	54,720	4	125,832	2	120,143	5	126,812	3	71,637
Los Angeles and Orange counties	12	878,478	14	3,015,159	13	2,453,981	14	863,677	12	1,222,598	16	3,079,447
Subtotals	89	$4,470,340	83	$6,639,597	96	$5,891,917	92	$3,174,304	100	$4,149,298	129	$8,551,693
Miscellaneous and marketing companies	7	4,401,218	8	9,509,009	9	9,384,308	13	9,926,044	13	*38,383,270	12	#40,981,214
Totals	96	$8,871,558	91	$15,548,606	105	$15,276,225	105	$13,100,348	113	$42,532,568	141	$49,532,907

*Includes a 50% stock dividend of the Standard Oil Company.
#Includes a 33⅓% stock dividend of the Standard Oil Company.

Prices of Light and Heavy Oil and Operating Data, 1917.

Field	Price				Operating data					
					All companies			Dividend companies		
	Under 18° Baume	18° and over	Average price	Price to dividend companies	Barrels per well per day yield	Operating cost per well day	Operating cost per barrel	Barrels per well per day yield	Operating cost per well day	Operating cost per barrel
Coalinga	$0.777	$0.958	$0.825	$0.843	28.3	$8.49	$0.300	29.2	$8.41	$0.288
Kern River	.857		.857	.840	9.9	2.63	.266	12.2	3.01	.247
Midway	.933	1.035	.964	.955	41.4	10.60	.256	40.6	10.60	.261
Sunset	.847	.811	.826	.825	34.9	7.71	.221	42.6	8.31	.195
McKittrick, Belridge and Lost Hills	.731	.987	.777	.742	31.4	6.91	.220	30.1	6.38	.212
Santa Barbara County	.747	.852	.808	.838	41.3	7.60	.184	34.9	3.32	.095
Ventura	.938	1.330	1.318	1.364	10.6	5.05	.476	15.6	6.65	.426
Los Angeles and Orange counties	1.076	1.131	1.110	1.141	30.5	5.67	.186	25.9	5.36	.207

Proved Oil Land.

The present extent of proved oil land in California as determined by the State Mining Bureau is 87,360 acres, of which 56,947 acres are in Kern County alone. Fresno County is second on the list with 12,993 acres. Estimates of the total amount of oil which can be recovered from the land are little better than pure guesses but it does seem most probable that the average acre will ultimately yield much less than fifty thousand barrels.

The areas of proved land are as follows:

County	Acres
Fresno	12,993
Kern	56,947
Los Angeles	2,401
Orange	3,418
Ventura	1,726
Santa Barbara	9,023
San Luis Obispo	772
Santa Clara	80
Total	87,360

CHAPTER THREE.

METALS.

The total value of metals produced in California during 1917 was $43,826,766. The chief of these is, and always has been, gold, followed in order in 1917 by copper, tungsten, zinc, quicksilver, silver, lead, manganese, antimony, platinum, molybdenum and iron. Deposits of ores of nickel and vanadium are also to be found in the state, although for 1917 there was no commercial output of them.

California leads all states in the Union in her gold production and the precious metal is widely distributed throughout the state. Twenty-six of the fifty-eight counties contain actively operated gold mines or dredges.

Copper, which is second in importance among the metals of the state, occurs in the following general districts: the Shasta County belt, which is by far the most important; the Coast Range deposits, extending more or less continuously from Del Norte in the north to San Luis Obispo County in the south; the Sierra Nevada foothill belt, starting in Plumas and running in a general southerly and southeasterly direction through the Mother Lode counties and ending in Kern; the eastern belt in Mono and Inyo counties; and the southern belt, in San Bernardino, Riverside, and San Diego counties.

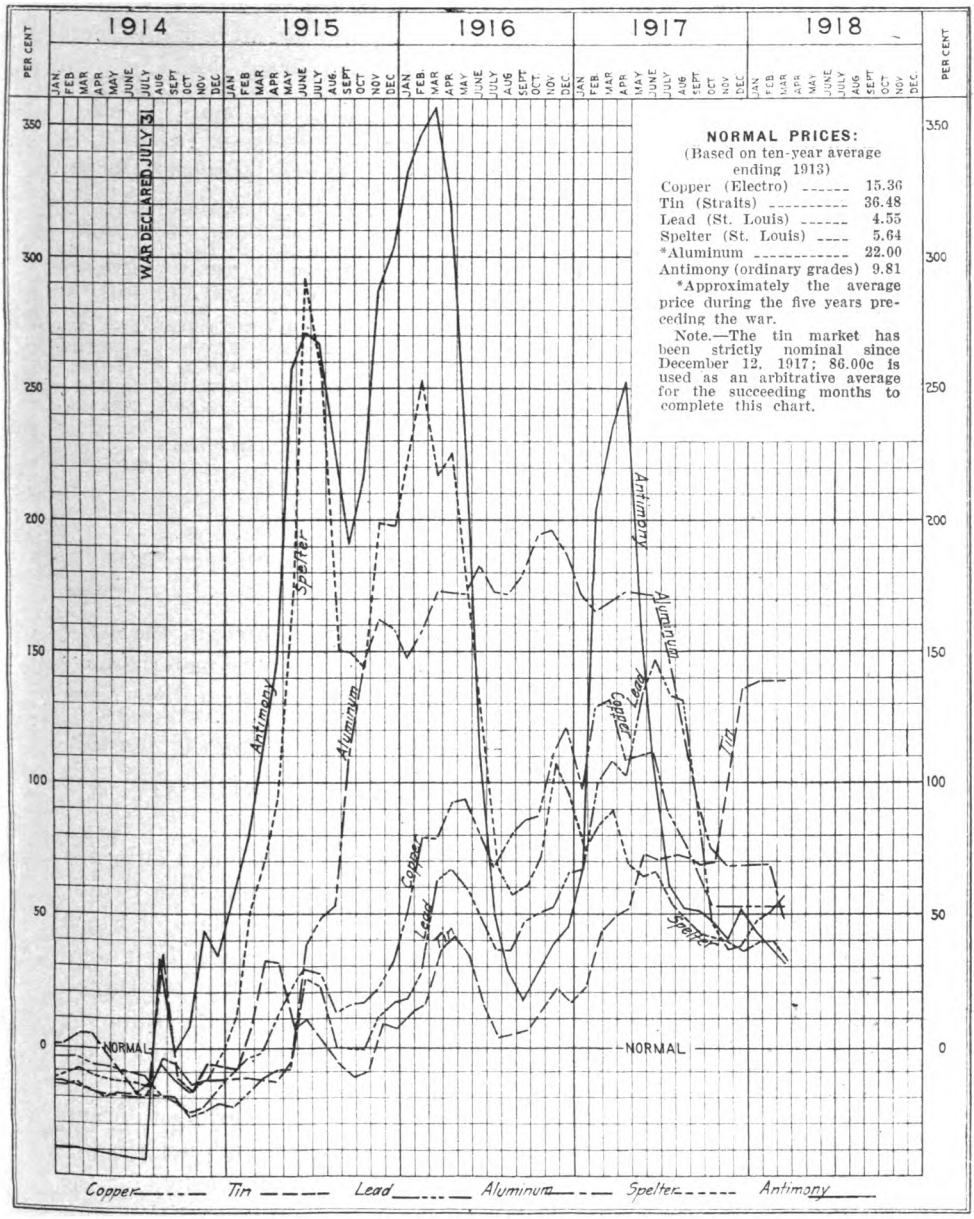
Silver is not generally found alone in the state, but is associated to a greater or less extent with gold, copper, lead, and zinc.

Quicksilver has for many years been one of the state's staple products and California supplies at least 75 per cent of the nation's output of this metal.

Tungsten is found in but few other localities of importance in the United States.

Large deposits of iron ore have long been known in many sections of the state, but for various economic reasons this branch of the mineral industry is still in its infancy here.

The fluctuations in the prices of aluminum, antimony, copper, lead, tin and zinc since the beginning of the war are shown by the chart herewith, reproduced from the Steel and Metal Digest.



Monthly price fluctuations of copper, tin, lead, spelter, antimony and aluminum since January, 1914, plotted on a percentage basis of above and below normal (zero). (After Steel and Metal Digest, April, 1918.)

A comparison of the 1917 metal output with that of 1916 is afforded by the following table:

Metal	1916		1917		Increase+ Decrease— value
	Amount	Value	Amount	Value	
Antimony ore	1,015 tons	$64,793	158 tons	$18,786	$46,007—
Cadmium			*	*	*
Copper	55,809,019 lbs.	13,729,017	48,534,611 lbs.	13,249,948	479,069—
Gold		21,410,741		20,087,504	1,323,237—
Iron ore	3,000 tons	6,000	2,874 tons	11,496	5,496+
Lead	6,196 tons	855,049	10,826 tons	1,862,016	1,006,967+
Manganese ore	13,404 tons	274,601	15,515 tons	396,659	122,058+
Molybdenum ore	8 tons	9,945	243 tons	9,614	931—
Platinum	886 ounces	42,642	610 ounces	43,719	1,077+
Quicksilver	21,427 flasks	2,003,425	24,382 flasks	2,396,466	393,041+
Silver		1,687,345		1,462,955	224,390—
Tungsten concentrates	2,270 tons	4,571,521	2,463 tons	3,079,013	1,492,508—
Zinc	15,950,565 lbs.	2,137,375	11,854,804 lbs.	1,209,190	928,185—
Totals		$46,792,454		$43,826,769	
Net decrease					$2,965,688—

*Concealed under unapportioned.

ALUMINUM.

Bibliography: Bulletins 38, 67.

No workable deposits of bauxite have been discovered in the state, although from time to time small quantities of the impure material have been the foundation of extravagant reports regarding such discoveries.

ANTIMONY.

Bibliography: State Mineralogist Reports XII, XIII, XIV, XV. Bulletin 38.

Antimony is known to exist in a number of places in California, having been reported from Kern, Inyo, Nevada, Riverside, San Benito, and Santa Clara counties. The Kern County deposits, some of which carry metallic antimony, are possibly the best known, and efforts were made to work some of them before California was a part of the United States. The commonest occurrence is in the form of the sulphide, stibnite. No continuous production, however, has been maintained, the output for 1915 being the first reported since 1901.

From the low point of 5.44¢ to 7.11¢ per pound, according to brand in July, 1914, the price of antimony rose gradually, though not steadily to 44¢ by the middle of January, 1916. American antimony, for the first time in many years, appeared on the market in competition with the Chinese and Japanese product. From $1.00 to $2.25 per unit was paid for ore, and at first a minimum of 50% accepted; but, later, some lower grade ore was smelted. The price remained at 44¢ (San Francisco quotations) until the middle of April, 1916, then declined quite rapidly to 10¢ in August. It remained around that figure and up to

14¢, closing the year at 12¢ per pound and $1.00 per unit. If the price drops below 12¢ per pound for the metal, few if any of the California mines can operate profitably. In 1917 the price made a sharp upward jump in March and April, but as sharply declined again immediately after.

During 1917 in California there was mined and sold a total of 158 tons of antimony ore, valued at $18,786, by eight producers in Kern County and one in San Benito County. The Wild Rose mine in Inyo County which made the largest individual output in 1916, did not operate in 1917. The Kern County ores carried 27%–53% antimony, and the San Benito ore 39.7%.

The production by years since 1887 has been as follows:

Year	Tons	Value	Year	Tons	Value
1887	75	$15,500	1899	75	$13,500
1888	100	20,000	1900	70	5,700
1893	50	2,250	1901	50	8,350
1894	150	6,000	1915	510	35,666
1895	33	1,485	1916	1,015	64,793
1896	17	2,320	1917	158	18,786
1897	20	3,500			
1898	40	1,200	Totals	2,363	$199,050

BISMUTH.

Bibliography: Bulletins 38, 67. Am. Jour. Sci. 1903, Vol. 16.

Several bismuth minerals have been found in California, notably native bismuth and bismite (the ochre) in the tourmaline gem district in San Diego and Riverside counties near Pala. Other occurrences of bismuth minerals, including the sulphide, bismuthinite, have been noted in Inyo, Fresno, Nevada, Tuolumne and Mono counties, but only in small quantities. The only commercial production recorded was 20 tons valued at $2,400, in 1904, and credited to Riverside County.

Recovery of bismuth from blister copper in the electrolytic refinery has been noted[6], ranging as high as 27.3 pounds of metallic bismuth per 100 tons of blister copper from the Iron Mountain, Shasta County, ores.

The uses of bismuth are somewhat restricted, being employed principally in the preparation of medicinal salts, and in low melting-point or cliché alloys. These alloys are utilized in automatic fire sprinkler systems, in electrical fuses, and in solders.

[6]Trans. Am. Inst. Min. Eng., Vol. 47, pp. 217–218.

CADMIUM.

In 1917, several thousand pounds of cadmium metal, in sticks, was recovered by the electrolytic zinc plant of the Mammoth Copper Company in Shasta County. This is the first commercial production of this metal recorded in California. As there was only the one producer, the exact figures and value are concealed under the 'unapportioned' item.

The cadmium occurs associated with the zinc sulphide, sphalerite, probably as the sulphide, greenockite. The principal uses of cadmium are in low-melting point, or cliché alloys, and in the manufacture of paint pigments. The cadmium alloys are said to be superior for some purposes to similar bismuth compounds.

COPPER.

Bibliography: State Mineralogist Reports VII, XIII, XIV, XV. Bulletins 23, 50.

Copper is one of the staple mineral products of the state, being produced chiefly in Shasta County, with smaller amounts but in excess of one million pounds of copper each, from Calaveras, Placer, Plumas and Trinity counties. In 1917, some yield in greater or less amount, was reported from a total of 26 counties. The production for the year was 48,534,611 pounds, valued at $13,249,948, which is a decrease of about $\frac{1}{7}$ in quantity, but of only about $\frac{1}{25}$ in total value as compared with 1916. The European war has caused a greatly increased demand for copper to make brass for shells of all calibers, as well as other requirements. This has raised the price from the 1914 average of 13.3¢ to 17.5¢ per pound in 1915; 24.6¢ in 1916; and 27.3¢ in 1917. On September 21, 1917, the U. S. Government fixed copper prices at 23.5¢ per lb. for large lots, and 24.67½¢ for small lots, effective until June 1, 1918.

Improvements have been made in the method of handling smelter smoke. Flotation concentration is being successfully employed by the Engels Copper Company and at the Walker Mine in Plumas County, by the Calaveras Copper Company in Calaveras County, and by the Mammoth Copper Company in Shasta County, and some others.

Distribution of the output, by counties, for 1917, was as follows:

County	Pounds	Value
Amador	19,352	$5,283
Calaveras	7,720,861	2,107,795
El Dorado	18,982	5,182
Fresno	40,662	11,101
Inyo	175,273	47,850
Kern	251,225	68,584
Madera	372,123	101,590
Mariposa	53,381	14,573
Nevada	40,165	10,965
Placer	710,601	193,994
Plumas	7,462,870	2,037,364
Riverside	28,838	7,873
San Bernardino	1,220,356	333,157
San Diego	159,349	43,502
Shasta	28,009,990	7,646,727
Sierra	13,031	3,558
Siskiyou	888,043	242,436
Tuolumne	32,840	8,965
Butte, Del Norte, Glenn, Imperial, Mono, Napa, Orange, Trinity, Tulare*	1,316,669	359,449
Totals	48,534,611	$13,249,948

*Combined to conceal output of individual mines in each.

Amount and value of copper production in California annually since such records have been compiled by the State Mining Bureau is given in the following tabulation:

Year	Pounds	Value	Year	Pounds	Value
1887	1,600,000	$192,000	1904	29,974,154	$3,969,995
1888	1,570,021	235,303	1905	16,997,489	2,650,605
1889	151,505	18,180	1906	28,726,448	5,522,712
1890	23,347	3,502	1907	32,602,945	6,341,387
1891	3,397,455	424,675	1908	40,868,772	5,350,777
1892	2,980,944	342,808	1909	65,727,736	8,478,142
1893	239,682	21,571	1910	53,721,032	6,680,641
1894	738,594	72,486	1911	36,838,024	4,604,753
1895	225,650	21,901	1912	34,169,997	5,638,049
1896	1,992,844	199,519	1913	34,471,118	5,343,023
1897	13,638,626	1,540,666	1914	30,491,535	4,055,375
1898	21,543,229	2,475,168	1915	40,968,966	7,169,567
1899	23,915,486	3,990,534	1916	55,809,019	13,729,017
1900	29,515,512	4,748,242	1917	48,534,611	13,249,948
1901	34,931,788	5,501,782			
1902	27,860,162	3,239,975	Totals	733,340,552	$118,333,300
1903	19,113,861	2,520,997			

GOLD.

Bibliography: State Mineralogist Reports, I to XV (inc.). Bulletins 36, 45, 57. U. S. G. S., Prof. Pap. 73.

Gold is one of the most important mineral products of California. For a number of years up to 1916 there was a marked tendency toward increased activity in gold mining, as investors realized that many of the mines and prospects have not been exhausted. The increase in costs of all supplies, labor and transportation due to the war, has made it increasingly difficult for the gold miner to keep his "head above water." The gold output of not only California, but of the other western, gold states is showing an alarming decrease. The Secretary of the Treasury, recently stated that: "At no time has this country so much required the largest possible production of gold as at present. Next to food and ammunition, gold is one of the most-needed war essentials. In order to place the enormous amount of Government bonds required to finance our war expenditures a large credit structure will inevitably be erected on our gold reserves, and it is necessary that these reserves, which are the foundation of the structure, shall be maintained on the broadest possible basis."

At a recent conference in San Francisco between The Director of the Mint and the principal California gold producers, concrete examples of the effects of the situation were presented. The figures given by one of the large operators on the Mother Lode are typical: In 1914, it cost that company $12 per fine ounce to produce the gold in the bullion shipped; in 1915, $14; in 1916, $16; in 1917, $18; and for the first six months of 1918, the cost was $20 per oz. Their output has averaged $700,000 per year for several years past. It must be borne in mind that the gold miner *receives* from the Mint, $20 per fine oz. for the gold.

It does not seem feasible to raise the value per ounce of fine gold, as that would upset financial calculations the world over, as gold is the basis against which everything else is figured. Possibly some sort of preference or priority can be given to gold mines in the matter of supplies and transportation; or a subsidy for the period of the war. The situation really is serious, and is being given serious consideration.

The State Mining Bureau has never independently collected statistics of gold and silver production, as there is no necessity for duplicating the very thoroughly organized work of the U. S. Geological Survey covering those metals. The data here given relative to these two metals has been received through the courtesy and coöperation of Mr. Charles G. Yale, Statistician in Charge of the San Francisco branch office of the Division of Mineral Resources. Anyone wishing fuller details of the production of these metals may obtain the same by applying to the U. S. Geological Survey, Washington, D. C., or to Room 305, U. S.

Custom House, San Francisco, Cal., for a copy of the "separate" on the subject.

"In 1917 there were 490 properties reporting production in California, of which 241 were deep mines and 249 placers. The producing deep mines of 1917 may be classified by chief metallic product as follows: Gold, 145; copper, 48; silver, 3; silver-lead, 24; lead, 19; and zinc, 2. Of the placer mines 71 were hydraulic—16 less than in 1916; 55 were dredges—5 less than in 1916; 53 were drift—14 less than in 1916; and 70 were surface or sluicing mines—6 less than in 1916. There were altogether 43 less placer mines producing than in 1916. Of the deep mines there were 59 less gold mines, 12 less copper, 2 more silver, 6 more silver-lead and 1 less zinc; there were, therefore, 56 less deep mines productive in 1917 than in 1916. The dredges are enumerated by the number of boats at work, some companies operating only one and others several.

"The total value of the gold, silver, copper, lead and zinc produced in California in 1917 shows a decrease of 5.19 per cent. Gold showed a decrease of 6.18 per cent. In copper the decrease was 14 per cent in quantity and 4 per cent in value; in zinc it was 2.87 per cent in quantity and 4.57 per cent in value; in lead there was an increase of 7.62 per cent in quantity and 1.19 per cent in value; in silver a decrease of 3.07 per cent in quantity and 13.29 per cent in value. The yield of gold from deep mines decreased 14.19 per cent, and the placers increased their yield 5.81 per cent.

* * *

"The total production of gold in California in 1917 was 971,732.99 fine ounces, valued at $20,087,504, a decrease of 64,011.60 fine ounces, valued $1,323,237. The deep mines of the state yielded 532,776.80 fine ounces of gold, valued at $11,013,474. Of the deep mine gold 93 per cent was derived from siliceous ore, 6 per cent from copper ore, .008 per cent from silver-lead ore and the remainder from lead and zinc ores.

"The decrease in the gold output of the state was due to war conditions which brought about much higher costs of labor and supplies, causing a curtailment of operations among the larger mines and a total stoppage of work on smaller ones, as explained more in detail in another portion of this chapter. While the deep-mine gold output was materially decreased, that from the placers was increased by $498,373, due mainly to larger returns of the gold dredging operations. The dredges yielded $544,300 in 1917 more than in 1916. Since gold dredging commenced in California in 1898, the total output of gold from that source to the end of 1917 has been $95,186,985. Since 1898 the Oroville (Butte County) dredging field has yielded $30,160,486, not including $2,058,192 derived in the last eight years from adjacent districts in the same county. The Marysville (Yuba County) field has produced from 1903 to 1917, inclusive, $28,119,067 in gold; the Folsom (Sacramento County) field has yielded since 1902 from dredging gold valued at $21,835,675. Quite a large number of dredges operated in various localities in other counties of the state, but their output of gold is not included in these figures relating to the more extensive dredge fields named.

"The placer yield of gold in 1917 in California was 438,956.19 fine ounces, valued at $9,074,030. The placer mines produced 45 per cent of the gold yield of 1917, and the deep mines 55 per cent, as compared with 40 per cent for the placers in 1916 and 60 per cent for the deep mines. The dredges produced 41 per cent of the total gold yield from all sources in 1917. Of the total placer gold, the dredges produced 91.6 per cent, the hydraulic mines 3 per cent, the drift mines 4 per cent, and the surface or sluicing mines 1.4 per cent. It is probable that this percentage from surface placers is too high since in the returns received at the office of the United States Geological Survey large numbers of miners classify themselves as working placers without specifying the exact kind. Some of these may have been small hydraulic or drift mines instead of mere surface sluicing mines. The three larger and more important dredging fields of the State are at Oroville, Butte County; Folsom, Sacramento County; and Marysville, Yuba County. Dredges are also operated in 7 other counties—5 in Calaveras, 1 in Merced, 3 in Placer, 3 in Shasta, 3 in Siskiyou, 1 in Stanislaus, and 4 in Trinity. The Yuba County dredges, 12 in number, made the largest output of gold in 1917, the value being $3,659,211, an increase of $519,061 as compared with 1916. Sacramento County with 12 dredges at work made an output of $1,913,504, an increase of $84,026. In Butte County (including Oroville and the 'outside' districts) 11 dredges produced $839,141, or $371,733 less than in 1916. This statement shows that $231,354 more gold was obtained in these three districts in 1917 than in 1916, although one of them—the oldest—shows a material decrease.

"Of the 26 counties producing gold in 1917 in California, 5 yielded no placer gold, and 6 yielded no gold from deep mines. Five counties produced more than $1,000,000 each in gold in 1917 as follows: Nevada, $3,682,947; Yuba, $3,677,673; Amador, $3,664,164; Sacramento, $1,919,581; and Calaveras, $1,471,442. The leading hydraulic mining county was Siskiyou; the greatest producer of gold from drift mines was Placer; the largest producer of gold from dredges was Yuba; and the largest producer of gold from surface or sluicing mines was Siskiyou. The largest increase—$509,950—in gold in 1917, as compared with 1916, was in Yuba County, which was followed by Trinity, with $166,555.

* * *

"The principal counties which showed a decreased gold output in 1917, as compared with 1916, were as follows: Tuolumne, $547,152; Sierra, $339,828; El Dorado, $337,063; Butte, $334,960; Kern, $209,190. * * *

* * *

"From the siliceous ore and tailings the recovery of gold by methods of treatment in California in 1917 was as follows: By amalgamation, 376,089.25 fine ounces, valued at $7,774,455; by cyanidation, 22,649.32 fine ounces, valued at $468,203; by chlorination, 9,100.74 fine ounces, valued at $188,129; from concentrates sent to smelters for treatment, 85,284.79 ounces, valued at $1,762,993. These figures may be considered

as approximate only since the smaller operators, many in number, kept no separate accounts; and even the larger companies do not always account for quantities of gold gained by separate systems of treatment.

* * *

"The 249 productive placer mines in California in 1917 yielded gold valued at $9,074,030, and 27,257 ounces of silver, valued at $22,460, a total value of $9,096,490. The increase in placer gold was $498,373 and the increase in the value of silver was $2,976. In production of gold the dredge properties showed an increase of $544,300, the hydraulic mines a decrease of $122,912, the drift mines an increase of $115,462, and the surface or sluicing mines a decrease of $38,477."

The gold production of California for 1917 was distributed, by counties, as follows:

County	Value	County	Value
Amador	$3,664,164	Placer	$538,686
Butte	922,271	Plumas	131,955
Calaveras	1,471,442	Sacramento	1,919,581
Del Norte	1,373	San Bernardino	154,976
El Dorado	24,758	Shasta	775,125
Fresno	5,745	Sierra	384,428
Humboldt	23,086	Siskiyou	325,550
Imperial	919	Trinity	602,048
Inyo	125,394	Tuolumne	321,085
Kern	537,852	Yuba	3,677,673
Madera	18,914	Merced and Stanislaus*	255,196
Mariposa	313,296		
Mono	209,040	Total	$20,087,504
Nevada	3,682,947		

*Combined to conceal output of a single property in each.

Total Gold Production of California.

The following table was compiled by Chas. G. Yale, of the Division of Mineral Resources, U. S. Geological Survey, but for a number of years statistician of the California State Mining Bureau and the U. S. Mint at San Francisco. The authorities chosen for certain periods were: J. D. Whitney, state geologist of California; John Arthur Phillips, author of "Mining and Metallurgy of Gold and Silver" (1867); U. S. Mining Commissioner R. W. Raymond; U. S. Mining Commissioner J. Ross Browne; Wm. P. Blake, Commissioner from California to the Paris Exposition, where he made a report on "Precious Metals" (1867); John J. Valentine, author for many years of the annual report on precious metals published by Wells Fargo & Company's Express; and Louis A. Garnett, in the early days manager of the San Francisco refinery, where records of gold receipts and shipments were kept. Mr. Yale obtained other data from the reports of the director of the U. S. Mint and the director of the U. S. Geological Survey. The authorities referred to, who were alive at the time of the original compilation of this table in 1894, were all consulted in person or by letter by Mr. Yale with reference to the correctness of their published data, and the final table quoted was then made up.

The figures since 1904 are those prepared by the U. S. Geological Survey:

Year	Value	Year	Value
1848	$245,301	1884	$13,600,000
1849	10,151,360	1885	12,661,044
1850	41,273,106	1886	14,716,506
1851	75,938,232	1887	13,588,614
1852	81,294,700	1888	12,750,000
1853	67,613,487	1889	11,212,913
1854	69,433,931	1890	12,309,793
1855	55,485,395	1891	12,728,869
1856	57,509,411	1892	12,571,900
1857	43,628,172	1893	12,422,811
1858	46,591,140	1894	13,923,281
1859	45,846,599	1895	15,334,317
1860	44,095,163	1896	17,181,562
1861	41,884,995	1897	15,871,401
1862	38,854,668	1898	15,906,478
1863	23,501,736	1899	15,336,031
1864	24,071,423	1900	15,863,355
1865	17,930,858	1901	16,989,044
1866	17,123,867	1902	16,910,320
1867	18,265,452	1903	16,471,264
1868	17,555,867	1904	19,109,600
1869	18,229,044	1905	19,197,043
1870	17,458,133	1906	18,732,452
1871	17,477,885	1907	16,727,928
1872	15,482,194	1908	18,761,559
1873	15,019,210	1909	20,237,870
1874	17,264,836	1910	19,715,440
1875	16,876,009	1911	19,738,908
1876	15,610,723	1912	19,713,478
1877	16,501,268	1913	20,406,958
1878	18,839,141	1914	20,653,496
1879	19,626,654	1915	22,442,296
1880	20,030,761	1916	21,410,741
1881	19,223,155	1917	20,087,504
1882	17,146,416		
1883	24,316,873	Total	$1,672,681,941

IRIDIUM (see under Platinum).

IRON ORE.

Bibliography: State Mineralogist Reports, II, IV, V, X, XII, XIII, XIV, XV. Bulletins 38, 67. Am. Inst. Min. Eng., Trans. LIII. Min. & Sci. Press, Vol. 115, pp. 112, 117-122.

Iron ore to the extent of 2,874 tons, valued at $11,496, was produced in San Bernardino and Shasta counties during the year 1917. It was utilized in the production of pig iron, ferro-manganese, ferro-silicon, and ferro-chrome mainly by electric furnace reduction.

There are considerable deposits of iron ore known in California, notably in Shasta, Madera, Placer, Riverside and San Bernardino counties, but production has so far been limited, on account of our having no economic supply of coking coal. Further developments

along the line of electrical smelting, or discoveries making available our petroleum fuel, for iron reduction, would lead to considerable increase of iron mining in California. For the present, at least, the most feasible possibilities lie in utilizing our iron resources in the preparation of the various alloys such as ferro-chrome, ferro-manganese, ferro-molybdenum, ferro-silicon and ferro-tungsten, by means of the electric furnace. California possesses commercial deposits and is now producing ores of all of the metals just enumerated. In addition to 2 electric smelting units now in operation, one blast furnace unit is working in Shasta County, and another in San Bernardino is said to be ready.

Total iron ore production in the state, with annual amounts and values, is as follows:

Year	Tons	Value	Year	Tons	Value
1881*	9,273	$79,452	1909	108	$174
1882	2,073	17,766	1910	579	900
1883	11,191	106,540	1911	558	558
1884	4,532	40,983	1912	2,508	2,508
1885			1913	2,343	4,485
1886	3,676	19,250	1914	1,436	5,128
1887			1915	724	2,584
1893	250	2,000	1916	3,000	6,000
1894	200	1,500	1917	2,874	11,496
1895					
1907	400	400			
1908			Totals	45,725	$301,724

*Productions for the years 1881-1886 (inc.) were reported as "tons of pig iron," (U. S. G. S., Min. Res. 1885), and for the table herewith are calculated to "tons of ore" on the basis of 47.6% Fe as shown by an average of analyses of the ores (State Mineralogist's Report IV, p. 242). This early production of pig iron was from the blast furnaces then in operation at Hotaling in Placer County. Charcoal was used in lieu of coke. Though producing a superior grade of metal, they were obliged finally to close down, as they could not compete with the cheaper English and eastern United States iron brought in by sea to San Francisco.

LEAD.

Bibliography: State Mineralogist Reports IV, VIII, X, XV.

Lead was produced during 1917, to the extent of 21,651,352 pounds which at 8.6¢ per pound was valued at $1,862,016, being an increase of over 75% in amount and more than double in value as compared to the previous year. The principal yield comes from Inyo County, followed by San Bernardino in second place. The ores are mined, and shipped to smelters. On account of the European war, the price increased from the 3.9¢ per pound average of 1914, to 4.7¢ in 1915; 6.9¢ in 1916, and 8.6¢ in 1917. The fluctuations in the price may be studied from the chart reproduced herewith at the beginning of this chapter on metals.

County returns for 1917, showing amounts and values, were:

County	Pounds	Value	County	Pounds	Value
Butte	378	$32	San Bernardino	2,293,541	$197,245
Calaveras	6,395	550	Shasta	8,725	750
Inyo	19,318,642	1,661,403	Siskiyou	192	17
Kern	9,684	833	Tuolumne	997	86
Madera	221	19	Amador, Nevada,		
Mariposa	1,075	92	Orange*	8,433	725
Mono	1,912	164			
Riverside	1,157	100	Totals	21,651,352	$1,862,016

*Combined to conceal output of a single mine in each.

Statistics on lead production in California were first compiled by this Bureau in 1887. Amount and value of the output, annually, with total figures, to date, are given in the following table:

Year	Tons	Value	Year	Tons	Value
1887	580	$52,200	1904	62	$5,270
1888	450	38,250	1905	266	25,083
1889	470	35,720	1906	169	19,307
1890	400	36,000	1907	164	16,690
1891	570	49,020	1908	562	46,663
1892	680	54,400	1909	1,343	144,897
1893	333	24,975	1910	1,508	134,082
1894	475	28,500	1911	701	63,173
1895	796	49,364	1912	685	61,653
1896	646	38,805	1913	1,820	160,202
1897	298	20,264	1914	2,349	183,198
1898	328	23,907	1915	2,398	225,426
1899	360	30,642	1916	6,196	855,049
1900	520	41,600	1917	10,826	1,862,016
1901	360	28,820			
1902	175	12,230			
1903	55	3,960	Totals	36,545	$4,371,366

MANGANESE.

Bibliography: State Mineralogist Reports XII, XIII, XIV, XV. Bulletins 38, 67. U. S. G. S., Bull. 427.

In the statistical reports previous to 1915, manganese ore was included in the 'industrial materials' list. We have since made a transfer, and now place it under 'metals,' because by far the greater tonnage of manganese ore is utilized in the preparation of ferro-manganese and employed in the steel industry both for its metal content and to slag off certain impurities during the open-hearth treatment. Though its other uses may be classed as 'chemical,' the tonnage thus consumed is relatively smaller. Its chemical uses are as a decolorizer or oxidizer in glass manufacture, and as a constituent in electric dry batteries. The chemical uses require a much higher grade of ore than the steel industry. For steel purposes, an iron content is acceptable, but manganese

should exceed 40%. Silica should be under 8%, though higher has been taken during the present increased demand. Phosphorus should be under 0.20%. For electric dry cells, the iron content should be under 1.5% Fe_2O_3, and SiO_2, under 6%. For glass making the manganese should be practically free of iron. The writer has recently been informed that on account of the high prices prevailing for manganese, it is being superseded in the glass factories by selenium.

The following schedule of prices for domestic ore was arranged by the American Iron and Steel Institute, and approved by the War Industries Board, effective indefinitely after May 28, 1918:

"Prices are per unit of metallic manganese per long ton (2240 lb.), for ore mined and shipped from all points west of South Chicago, Illinois. The prices are on basis of delivery, f.o.b. cars South Chicago. When shipped to other destinations than Chicago, the freight-rate per gross ton from shipping point to South Chicago is to be deducted to give the price f.o.b. shipping point. For ore shipped to points east of Chicago, 15c per unit is to be added to the schedule given below. Chemical ores are not included. Prices are based on ore dried at 212° F.

Mn, %	Per unit	Mn, %	Per unit
35 to 35.99	$0.86	45 to 45.99	$1.12
36 to 36.99	0.90	46 to 46.99	1.14
37 to 37.99	0.94	47 to 47.99	1.16
38 to 38.99	0.98	48 to 48.99	1.18
39 to 39.99	1.00	49 to 49.99	1.20
40 to 40.99	1.02	50 to 50.99	1.22
41 to 41.99	1.04	51 to 51.99	1.24
42 to 42.99	1.06	52 to 52.99	1.26
43 to 43.99	1.08	53 to 53.99	1.28
44 to 44.99	1.10	54 and over	1.30

"These prices are net to producer, buyers to pay salary or commission of their agents. In payment, 80% of estimated value of the ore (less moisture and freight from shipping point) to be paid against railroad bill-of-lading, with attached analysis, balance on receipt of ore by buyer.

"The above prices are based on ore carrying not over 8% silica and 0.25% phosphorus. Bonuses and penalties are as under:

Bonuses		Penalties	
SiO_2, %	Per ton	SiO_2, %	Per ton
Each 1% between 8 and 5%	$0.50	Each 1% from 8 to 15%	$0.50
Each 1% under 5%	1.00	Each 1% from 15 to 20%	0.75
		Each 1% from 20 to 25%	1.00

"For each 0.01% in excess of 0.25% phosphorus there is a penalty against unit price paid for manganese of ½% per unit figured to fractions."

Though the imports of manganese ore from the Caucasus district in Russia have been reduced by the war to practically nothing (about 1% of 1914 figures), the United States is receiving important shipments from Brazil, India, and Cuba: so that the total imports for 1916 were practically double those of either 1914 or 1915. The 1916 figures were 576,321 long tons, valued at $8,666,179; and for 1917, a total of 629,972 long tons, valued at $10,262,929, of which 512,517 tons were from Brazil. The increased demand for steel products has increased the necessity for ferro-manganese, which is used largely in the open-hearth process of steel making. This resulted in curtailment of ferro-manganese exports from England, and the resulting shortage in the United States has been met by the greater imports of manganese ore from Brazil especially, and an increased domestic production both of ore and ferro-manganese. These conditions have caused the prices for the ores to range from $20–$50 per ton, f.o.b. rail, California, for the steel grades, to above $75 for chemical grades.

Much of the state's 1917 product was utilized in California in making ferro-manganese by electric furnace; besides shipments which were sent East. Some 'chemical' ore was also shipped. For many years the principal producing section has been the Livermore-Tesla district, in Alameda and San Joaquin counties, but exceeded in 1915 by Mendocino and regaining the lead in 1916. Manganese is reported to exist in many localities in the state; but past production, particularly since the discontinuance of the chlorination process in the metallurgy of gold, has been relatively unimportant until the present activity.

The production of manganese ore in California for 1917 amounted to 15,515 tons of all grades, having a total value of $396,659 f.o.b. rail-shipping point. This is an increase both in quantity and value over the 1916 figures which nearly equaled the entire previous tonnage, 1887–1915, and was about double the value for the same period.

The 1917 output was distributed by counties as follows:

County	Tons	Value	County	Tons	Value
Alameda	1,211	$30,250	Santa Clara	760	$18,606
Glenn	369	9,721	Sonoma	362	12,689
Imperial	1,907	38,140	Stanislaus	775	26,925
Lake	85	1,900	Amador, Butte, Riverside, San Luis Obispo, Trinity*	410	14,683
Mendocino	1,541	40.515			
Plumas	1,540	39,680			
San Bernardino	235	6,050			
San Joaquin	6,320	157,500	Totals	15,515	$396,659

*Combined to conceal output of a single mine in each.

There are now two electric smelters in operation in California making ferro-alloys: the plant of the Noble Electric Steel Company at Heroult, Shasta County, and the new one of the Pacific Electro Metals Company at Bay Point, Contra Costa County.

The production of manganese ore in California annually since 1887 follows:

Year	Tons	Value	Year	Tons	Value
1887	1,000	$9,000	1904	60	$900
1888	1,500	13,500	1905		
1889	53	901	1906	1	30
1890	386	3,176	1907	1	25
1891	705	3,830	1908	321	5,785
1892	300	3,000	1909	3	75
1893	270	4,050	1910	265	4,235
1894	523	5,512	1911	2	40
1895	880	8,200	1912	22	400
1896	518	3,415	1913		
1897	504	4,080	1914	150	1,500
1898	440	2,102	1915	4,013	49,098
1899	295	3,165	1916	13,404	274,601
1900	131	1,310	1917	15,515	396,659
1901	425	4.405			
1902	870	7,140			
1903	1	25	Totals	42,558	$810,159

MOLYBDENUM.

Bibliography: Report XIV; Bulletin 67. U. S. Bur. of M., Bulletin 111. Proc. Colo. Sci. Soc., Vol. XI.

Molybdenum, as the metal, is used as an alloy constituent in the steel industry, and in certain forms of electrical apparatus. Included in the latter, is its successful substitution for platinum and platinum-iridium in electric contact-making and breaking devices. In alloys it is used similarly to and in conjunction with chromium, cobalt, iron, manganese, nickel, tungsten, and vanadium. The oxides and the ammonium salt have important chemical uses.

The two principal molybdenum minerals are: the sulphide, molybdenite; and wulfenite, lead molybdate, the former furnishing practically the entire commercial output. Molybdenite is found in or associated with acidic igneous rocks, such as the granites and pegmatites. Up to 1916, at least, the chief commercial sources have been New South Wales, Queensland and Norway.

Deposits of disseminated molybdenite are known in several localities in California, and in at least two places it occurs in small masses associated with copper sulphides. In 1916, was recorded the first commercial shipments of molybdenum ore in California.

The 1917 output amounted to 243 tons valued at $9,014, and included some concentrates assaying up to 58% MoS_2, but the bulk of it was 1.5% ore which was shipped to Denver, Colorado, for concentration. This production came mainly from Shasta County, with smaller amounts from Inyo, Mono and San Diego counties. There are now two concentrating plants operating in California,—one in each of the first and last-named above counties.

The California production of molybdenum ore by years is summarized in the following tabulation:

Year	Tons	Value
1916	8	$9,945
1917	243	9,014
Totals	251	$18,959

NICKEL.

Bibliography: Report XIV. U. S. G. S., Bulletin 640–D.

Nickel occurs in the Friday Copper Mine in the Julian District, San Diego County. The ore is a nickel-bearing pyrrhotite, with some associated chalcopyrite. Some ore has been mined during the past three years in the course of development work, but not treated nor disposed

of, as they are as yet unable to get any smelter to handle it for them. Nickel ore has also been reported from Siskiyou County, west of Gazello and from San Bernardino County.

OSMIUM (see under Platinum).

PALLADIUM (see under Platinum).

PLATINUM.

Bibliography: State Mineralogist Reports IV, VIII, IX, XII, XIII, XIV. Bulletins 38, 45, 67. U. S. G. S., Bull. 285.

In California platinum is obtained as a by-product from placer operations for gold. The major portion of it comes from the dredges operating in Butte, Calaveras, Sacramento and Yuba counties, while the hydraulic and surface sluicing mines of Del Norte, Humboldt, Siskiyou and Trinity and the dredges of Merced and Stanislaus yield a smaller amount.

The production for 1917 amounted to 610 ounces of crude platinum—group metals, valued at a total of $43,719. Of this amount a total of 552 oz., or 91%, came from the gold dredges. Crude platinum varies considerably in its purity. That marketed during the year 1914,[7] is stated to have averaged 51% platinum, 3% iridium, and 30% iridosmine or osmiridium. Some platinum is also recovered in the electrolytic refining of blister copper. It has been found[8] that blister copper from several smelters in the United States carries from 0.342 oz. to 1.825 oz. platinum and from 0.607 oz. to 4.402 oz. palladium per 100 tons of blister copper treated. That from Iron Mountain, Shasta County, California, also yields some platinum and palladium. Iron in greater or less amount is always alloyed naturally with native platinum, and usually some iridium and osmium.

For 1917, the distribution, by counties, was as follows:

County	Ounces	Value	County	Ounces	Value
Butte	119	$9,106	Yuba	149	$8,869
Calaveras	20	1,433	Amador, El Dorado,		
Del Norte	10	853	Merced, Nevada,		
Humboldt	6	351	Placer, San Joaquin,		
Sacramento	157	12,453	Stanislaus*	70	5,562
Shasta	14	1,100			
Siskiyou	15	709			
Trinity	50	3,283			
			Totals	610	$43,719

Russia previous to the war, was producing from 90% to 95% of the world's platinum; but, according to U. S. Consular Reports, the yield for 1916 was reduced to one-third of the normal, on account of the

[7] U. S. G. S., Min. Res., 1914, Pt. I, p. 336.
[8] Trans. Am. Inst. Min. Eng., vol. 47, pp. 217–218, 1913.

"scarcity of labor in the case of hand washings by tributers, and in the case of mechanical dredging plants by the difficulty in obtaining spare parts for dredges"—both, a reflection of war conditions. Since then it has now practically ceased entirely.

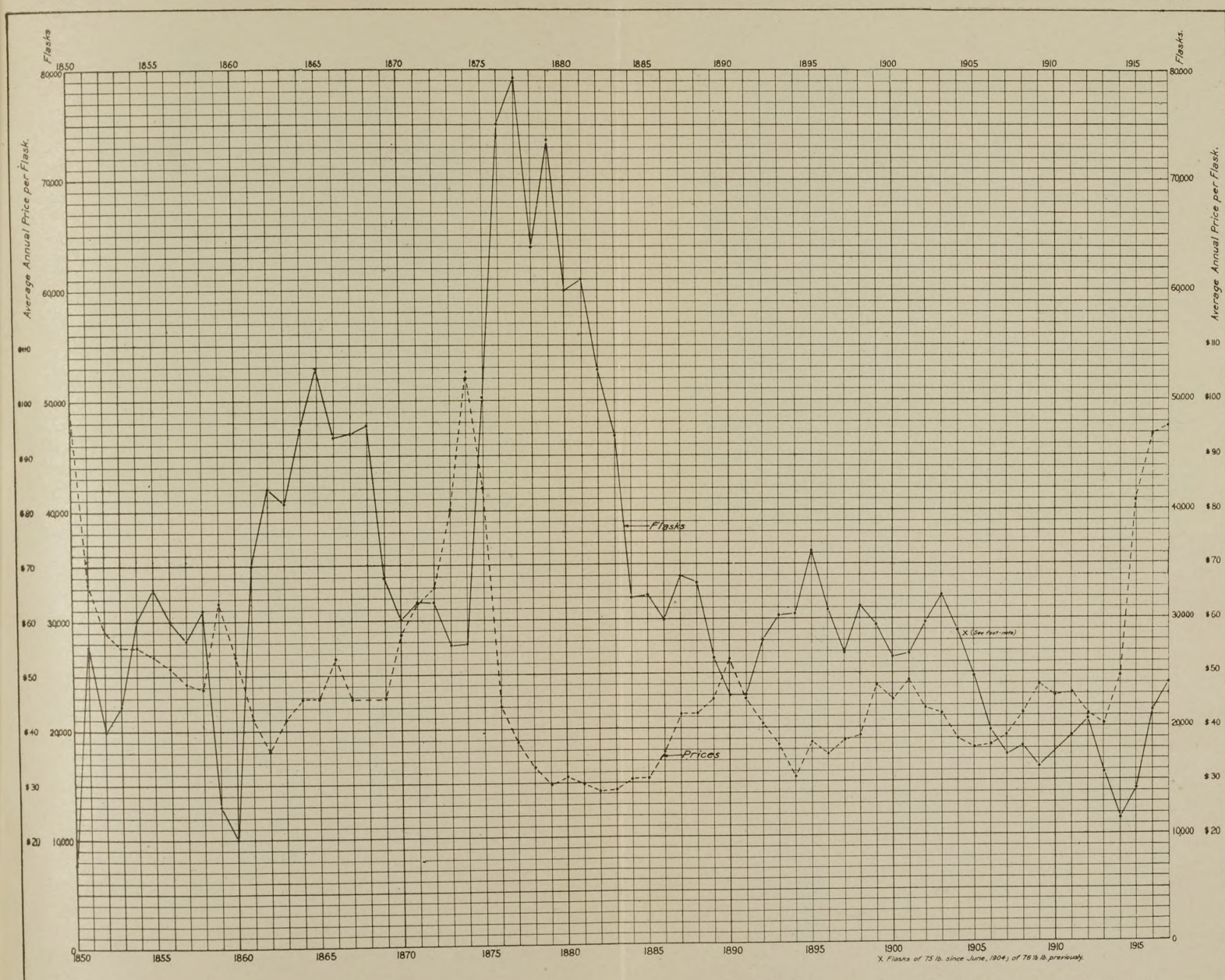
The price of the metal has consequently risen to over $100 per troy fine ounce. During 1916, it varied from $90 in January, to $55 in August, $105 December 1st, and closing the year at $82. The 1917 price was from $100 to $105. In 1916, the miners of California received from $43 to $76 per ounce for their crude platinum, and an average of $45.50, as against $29 to $38 per ounce during 1915. In 1917, they received an average of $72 per ounce. The U. S. Government is commandeering all new platinum produced at a fixed price of $105 per fine ounce. The refiners are licensed and must turn over all stocks to the Government. The miners may sell to the refiners, or to the Government (War Industries Board, Platinum Section) direct.

Next in importance to Russia as a producer of platinum is Colombia. California is the leading producer in the United States. There have been occasional reports of platinum in California being found in vein materials, but as yet no authentic case has come to the notice of the laboratory of the State Mining Bureau. In this connection, however, the recent report[9] of an analysis of chromite from Del Norte County showing 0.04 oz. platinum per ton is of more than passing interest, and apparently reliable. Platinum and chromite are alike in their association with serpentine derived from basic igneous rocks such as periodotite, pyroxenite and dunite. The two have been found intergrown in dunite on the Tulameen River in British Columbia.

Besides its well-known uses in jewelry, dentistry and for chemicalware, an important industrial development of recent years, employs platinum as a catalyzer in the 'contact process' of manufacturing concentrated sulphuric acid. It is also necessary for certain delicate parts of the ignition systems in automobiles, motor boats, and aeroplanes.

Because of the effect of the limited supply and the high prices of platinum on the present industrial situation, the jewelers' and dentists' associations have voluntarily agreed to curtail consumption of this metal so far as possible. Experiments are being made to find alloys which can replace platinum for dishes and crucibles in analytical work, but so far with only slight success.

[9]Min. & Sci. Press, June 30, 1917, p. 929.



PRODUCTION AND PRICE OF QUICKSILVER IN CALIFORNIA, 1850-1917. Reproduced from Bulletin No. 78.

The annual production and value since 1887, have been as follows:

Year	Ounces	Value	Year	Ounces	Value
1887	100	$400	1904	123	$1,849
1888	500	2,000	1905	200	3,320
1889	500	2,000	1906	91	1,647
1890	600	2,500	1907	300	6,255
1891	100	500	1908	706	13,414
1892	80	440	1909	416	10,400
1893	75	517	1910	337	8,386
1894	100	600	1911	511	14,873
1895	150	900	1912	603	19,731
1896	162	944	1913	368	17,738
1897	150	900	1914	463	14,816
1898	300	1,800	1915	667	21,149
1899	300	1,800	1916	886	42,642
1900	400	2,500	1917	610	43,719
1901	250	3,200			
1902	39	468	Totals	10,151	$242,460
1903	70	1,052			

QUICKSILVER.

Bibliography: State Mineralogist Reports IV, X, XII, XIII, XIV, XV. Bulletins 27, 78. U. S. G. S., Monograph XIII.

Quicksilver was produced in 13 counties in 1917, to the amount of 24,382 flasks, valued at $2,396,466, which is an increase both in number of flasks and value over the year 1916. The European war has caused a considerable rise in the price of quicksilver, due to the prohibition of exports from Austria and Italy, and the retention of the Spanish output in England, to say nothing of its increased use in munitions manufacture. Immediate steps were taken by many to reopen old quicksilver properties which had been idle for many years.

Prices.

The following table of monthly San Francisco quotations per flask of 75 pounds, will indicate the decided change in the status of quicksilver during the year 1917, as compared with the pre-war price of about $37 per flask. As San Francisco is the primary domestic market for quicksilver, the average yearly quotations on this market have previously been used by the State Mining Bureau (and the U. S. Geological Survey, also) in calculating the value of the state's output of this metal. The 1914 figure was $49.05 per flask. However, because since the war there has been considerable speculation in quicksilver by parties other than the actual producers, and the price changes were often rapid, so that quotations did not always mean sales, we have since 1914 taken for the average value the average actual sales as reported to us by the producers. This gives us an average value of $81.52 per flask for the year 1915, instead of the $85.80 average of quotations; for 1916, $93.50 instead of $125.89; and for 1917, $98.29 instead of $106.33.

San Francisco Quotations of Quicksilver, 1917.

Month	Average price
January	$81 00
February	126 25
March	113 75
April	114 50
May	104 00
June	85 50
July	102 00
August	115 00
September	112 00
October	102 00
November	102 50
December	117 42

The U. S. Government is now taking 40% of the American output of quicksilver at a fixed price of $105 per flask. The balance can be sold in the open market at whatever price may there be put upon it. Quotations for the first half of 1918 have ranged between $110 and $120 per flask. The charts printed herewith are reproduced from Bulletin 78 of the State Mining Bureau, on the Quicksilver Resources of California, just off the press. One shows the production by flasks and value, annually since 1850, and the other, the variations in the San Francisco quotations 1914-March, 1918.

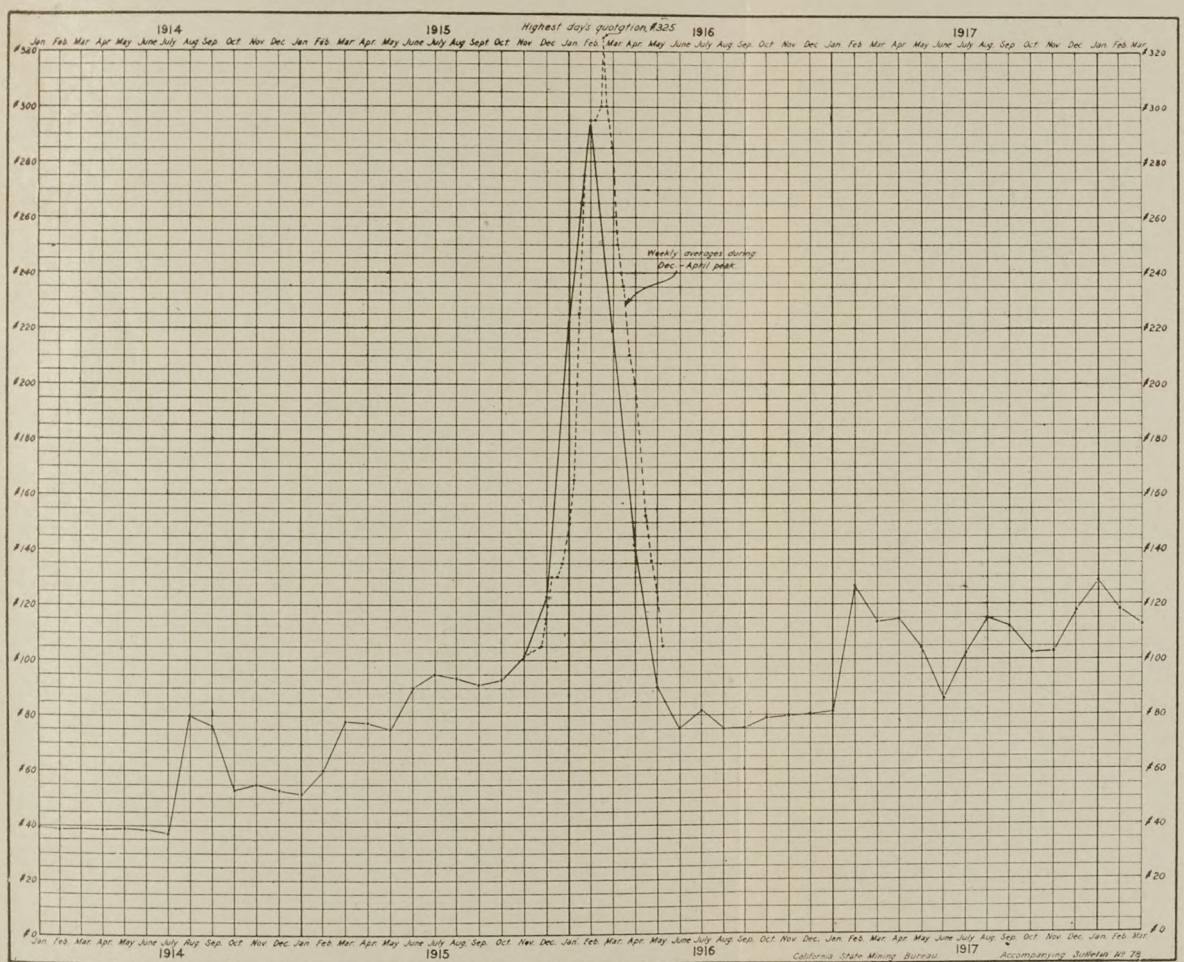
Recent consular reports[10] indicate that at the famous mines at Almaden, Spain, the expense of operation has increased somewhat. These mines are owned by the government and operated by contractors using convict labor. The cost of production of quicksilver is stated to have increased from $8.29 a flask in 1900 to $15.22 in 1915. Their ore is high-grade, the material sent to the furnaces averaging 9%–11% mercury.

For two or three years previous to the outbreak of the European war, our normal peace-times consumption of quicksilver in the United States was approximately 25,000 flasks annually; and our domestic production had fallen below 20,000 flasks per year. Of this 25,000-flask peace-time consumption, nearly 50% went into the manufacture of fulminate for explosive caps for mining, quarrying, and sporting arms ammunition as well as military ammunition. Our domestic production being inadequate, partly because of the low price and the lower average tenor of the ores mined, necessitated the importation of up to 5,000 flasks annually. The enormous increase in munitions manufacture due to the war has, of course, raised our requirements correspondingly.

The import duty of 10% *ad valorum* is not sufficient to protect our American miners against the competition of the convict-operated mines

[10]U. S. Commerce Reports, No. 298, Dec. 20, 1916, p. 1079; Annual Series, No. 15B, June 22, 1917, p. 33.

PLATE II.



MONTHLY AVERAGE QUICKSILVER QUOTATIONS AT SAN FRANCISCO, CALIFORNIA, JANUARY, 1914–FEBRUARY, 1918, INCLUSIVE.

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of Spain where quicksilver can be produced for as low as $8–$15 per flask, as noted above. The duty should be at least $25 per flask to give us proper protection. The present improvement in the price has increased the number of operating properties in California. Lower grade ores are being worked; and new methods of ore dressing and reduction are being tried.

From a consideration of the above facts and other circumstances of the situation, it would appear that the present economic level for the price of quicksilver should be above $100 per flask. This condition seems likely to continue at least as long as the war lasts.

A shipment of 300 flasks of quicksilver from the New Idria Mine, San Benito County.

Uses.

The important uses of quicksilver are the recovery of gold and silver by amalgamation, and in the manufacture of fulminate for explosive caps, of drugs, of electric appliances, and of scientific apparatus. By far the greatest consumption is in the manufacture of fulminate and drugs.

The newest use for quicksilver is the introduction of a small amount into the cylinders of steam turbines to improve the vapor pressure and thus increase efficiency. This mercury is recoverable and can be re-used, so that there is only a small proportional loss.

Quicksilver is an absolutely essential element from a military standpoint, as there has not yet been produced an entirely satisfactory commercial substitute for it in the manufacture of fulminating caps for explosives. However, in order to reduce consumption of the fulminate, some potassium chlorate, picric acid, trinitro-toluol, or tetranitromethalamine is stated at present as being mixed with it. The Ordnance Department of the U. S. Army, however, will accept no substitutes.

Concentration of Quicksilver Ores.

For the above reason, and the fact that California has been, and still is, producing from 70% to 80% of the quicksilver yield of the United States, an investigation of the possibilities of concentration for quicksilver ores, was undertaken by the State Mining Bureau. In the Bureau's investigation a wide variety of ores was tested by water concentration, flotation with oils, and a wet method by solution with an alkaline sulphide. Full details of this work, as well as furnace practices and descriptions of the California mines are given in Bulletin 78, referred to on a previous page.

Production.

Though some domestic yield of this metal is now obtained from Texas, Nevada, Arizona, and Oregon, the bulk of the output still comes from California.

The distribution of the 1917 product, by counties was:

County	Amount, flasks	Value
Kern	300	$27,250
Lake	1,067	107,071
Napa	834	78,320
San Benito	11,150	1,057,770
San Luis Obispo	1,565	151,034
Santa Clara	5,921	639,594
Solano	554	52,765
Sonoma	2,592	244,810
Fresno, Monterey, Santa Barbara, Trinity, Yolo*	399	37,852
Totals	24,382	$2,396,466

*Combined to conceal output of a single mine in each.

Total Quicksilver Production of California.

Total amount and value of the quicksilver production of California, as given in available records, is shown in the following tabulation. Though the New Almaden mine in Santa Clara County was first worked in 1824, and has been in practically continuous operation since 1846 (though the yield was small the first two years), there are no available data on the output earlier than 1850. Previous to June, 1904, a 'flask' of quicksilver contained 76½ pounds, but since that date 75 pounds. In compiling this table the following sources of information

were used: For 1850–1883, table by J. B. Randol, in Report of State Mineralogist, IV, p. 336; 1883–1893, U. S. Geological Survey reports; 1894 to date, statistical bulletins of the State Mining Bureau; also State Mining Bureau, Bulletin 27, "Quicksilver Resources of California," 1908, p. 10:

Year	Flasks	Value	Average price per flask	Year	Flasks	Value	Average price per flask
1850	7,723	$768,052	$99 45	1885	32,073	$986,245	$30 75
1851	27,779	1,859,248	66 93	1886	29,981	1,064,326	35 50
1852	20,000	1,166,600	58 33	1887	33,760	1,430,749	42 38
1853	22,284	1,235,648	55 45	1888	33,250	1,413,125	42 50
1854	30,004	1,663,722	55 45	1889	26,464	1,190,880	45 00
1855	33,000	1,767,150	53 55	1890	22,926	1,203,615	52 50
1856	30,000	1,549,500	51 65	1891	22,904	1,036,406	45 25
1857	28,204	1,374,381	48 73	1892	27,993	1,139,595	40 71
1858	31,000	1,482,730	47 83	1893	30,164	1,108,527	36 75
1859	13,000	820,690	63 13	1894	30,416	934,000	30 70
1860	10,000	535,500	53 55	1895	36,104	1,337,131	37 04
1861	35,000	1,471,750	42 05	1896	30,765	1,075,449	34 96
1862	42,000	1,526,700	36 35	1897	26,691	993,445	37 28
1863	40,531	1,705,544	42 08	1898	31,092	1,188,626	38 23
1864	47,489	2,179,745	45 90	1899	29,454	1,405,045	47 70
1865	53,000	2,432,700	45 90	1900	26,317	1,182,786	44 94
1866	46,550	2,473,202	53 13	1901	26,720	1,285,014	48 46
1867	47,000	2,157,300	45 90	1902	29,552	1,276,524	43 20
1868	47,728	2,190,715	45 90	1903	32,094	1,335,954	42 25
1869	33,811	1,551,925	45 90	1904	*28,876	1,086,323	37 62
1870	30,077	1,725,818	57 38	1905	24,655	886,081	35 94
1871	31,686	1,999,387	63 10	1906	19,516	712,334	36 50
1872	31,621	2,084,773	65 93	1907	17,379	663,178	38 16
1873	27,642	2,220,482	80 33	1908	18,039	763,520	42 33
1874	27,756	2,919,376	105 18	1909	16,217	773,788	47 71
1875	50,250	4,228,538	84 15	1910	17,665	799,002	45 23
1876	75,074	3,303,256	44 00	1911	19,109	879,205	46 01
1877	79,396	2,961,471	37 30	1912	20,600	866,024	42 04
1878	63,880	2,101,652	32 90	1913	15,661	630,042	40 23
1879	73,684	2,194,674	29 85	1914	11,373	557,846	49 05
1880	59,926	1,857,706	31 00	1915	14,199	1,157,449	81 52
1881	60,851	1,815,185	29 83	1916	21,427	2,003,425	93 50
1882	52,732	1,488,624	28 23	1917	24,382	2,396,466	98 29
1883	46,725	1,343,344	28 75				
1884	31,913	973,347	30 50	Totals	2,137,728	$101,992,560	

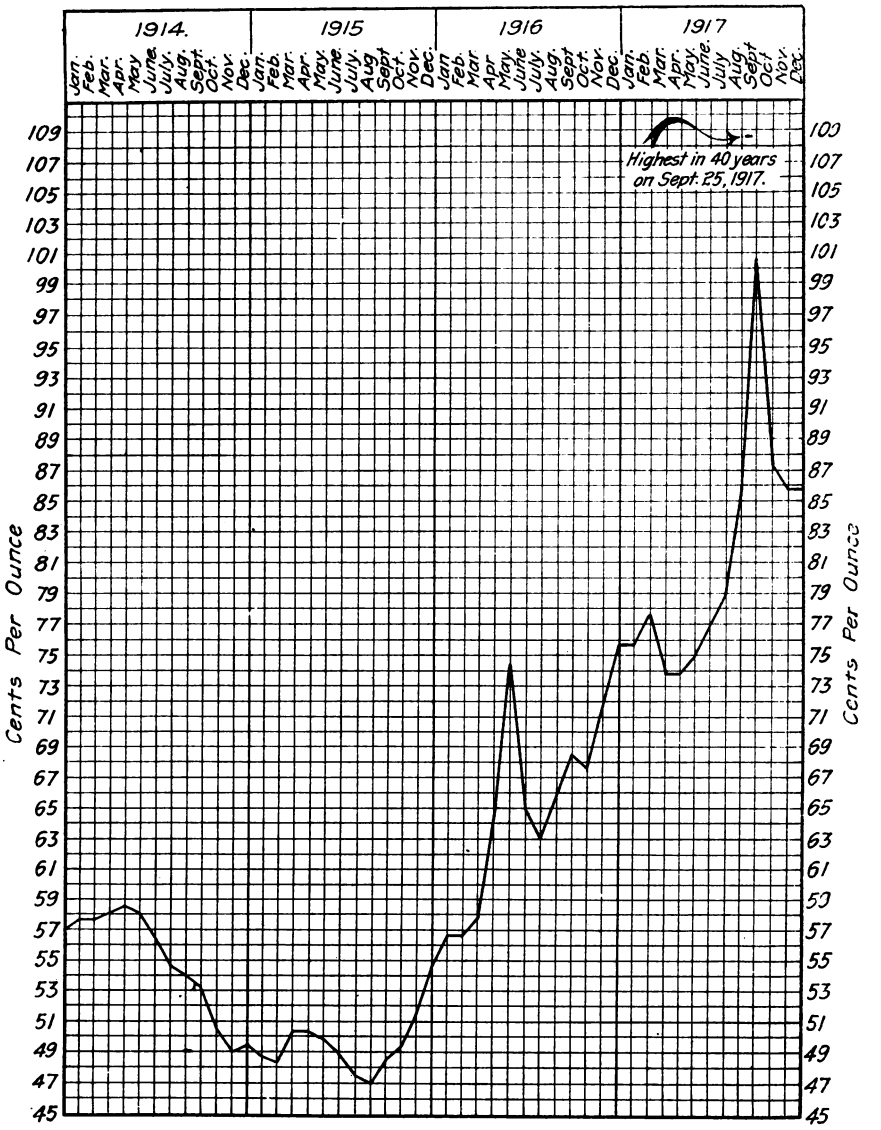
*Flasks of 75 lbs. since June, 1904; of 76½ lbs. previously.

SILVER.

Bibliography: State Mineralogist Reports IV, VIII, XII, XIII, XIV, XV. Bulletin 67.

Silver in California is produced largely as a by-product from its association with copper, lead, zinc and gold ores. As explained under the heading of Gold, the following figures are those of the U. S. Geological Survey. The average price of silver during 1917 was 82.4¢ per ounce at New York as compared with 54.8¢ in 1914; 50.7¢ in 1915; and

65.8¢ in 1916. The monthly variations in price are shown on the chart reproduced herewith.



Monthly Average Price of Silver for Four Years.

"The deep mine production of silver in California in 1917 was 1,748,174 ounces, valued at $1,140,495, a decrease in quantity of 786,569 ounces and in value $227,366. The larger portion of the output, 1,034,833 ounces, valued at $852,702, was derived from crude smelting ores. Siliceous ores, milled and smelted, yielded 139,492 ounces, valued at $114,941. The largest output of silver in 1917 came from Inyo County (not from Shasta as has been usual for years), which produced from copper ores 661 ounces, valued at $545; from siliceous ore, 550 ounces, valued at $453; from lead ores, 164,115 ounces, valued at $135,231; from silver-lead ores, 483,431 ounces, valued at $398,347; and from zinc ores, 28 ounces, valued at $23. This makes a total yield of silver from Inyo County, of 648,785 ounces, valued at $534,599. Shasta County followed Inyo in yield of silver, the output being 631,921 fine ounces, valued at $520,703 as compared with 1916 of 1,063,464 ounces in quantity and $595,074 in value. The total silver derived from deep mines of all classes and from placer mines in California in 1917 was 1,775,431 ounces, valued at $1,462,955. The silver obtained from refining placer gold mined in the State in 1917 was 27,257 ounces, valued at $22,460. The largest producer of placer silver was Yuba County—7,999 ounces, valued at $6,591.

"Silver, lead, and silver-lead mines are more numerous and productive since the advance in the price of the metal. Silver derived from purely silver ores in 1917 amounted to 8,378 fine ounces, valued at $6,903. From 63,999 tons of silver-lead ores there was derived 552,641 fine ounces of silver, valued at $455,376, as well as $96,402 in gold; from 28,080 tons of lead ore was obtained 165,155 ounces of silver, valued at $136,088; and from 135 tons of zinc ore, the silver yield was 28 ounces, valued at $23.

* * *

"From the siliceous ore and old tailings treated in California in 1917 the recovery of silver by amalgamation was 83,141 ounces, valued at $68,508; by cyanidation 29,937 ounces, valued at $24,668; by chlorination 283 ounces, valued at $233; and from concentrates sent to smelters 110,705 ounces, valued at $91,221. From smelting ores silver was recovered amounting to 1,524,108 fine ounces, and valued at $1,255,865. These figures do not include the comparatively small quantity of silver recovered from the gold in placer mining operations."

The distribution of the 1917 silver yield, by counties, was as follows:

County	Value
Amador	$21,358
Butte	2,991
Calaveras	87,984
Del Norte	8
El Dorado	85
Fresno	289
Humboldt	95
Imperial	5
Inyo	534,599
Kern	7,813
Madera	489
Mariposa	3,221
Mono	5,662
Nevada	52,335
Placer	13,885
Plumas	74,461
Sacramento	4,487
San Bernardino	88,930
Shasta	520,703
Sierra	1,629
Siskiyou	16,883
Trinity	10,021
Tuolumne	7,808
Yuba	6,591
Merced, Riverside, San Diego and Stanislaus*	623
Total	$1,462,955

*Combined to conceal output of a single producer in each.

The value of the silver produced in California each year since 1887, is as follows:

Year	Value	Year	Value
1887	$1,632,003	1901	$873,525
1888	1,700,000	1905	678,494
1889	754,793	1906	817,830
1890	1,060,613	1907	751,646
1891	953,157	1908	873,057
1892	463,602	1909	1,091,092
1893	537,157	1910	993,646
1894	297,332	1911	673,336
1895	599,789	1912	799,584
1896	422,463	1913	832,553
1897	452,789	1914	813,938
1898	414,055	1915	851,129
1899	504,012	1916	1,687,345
1900	1,510,344	1917	1,462,955
1901	1,229,356		
1902	616,412	Total	$26,865,451
1903	517,444		

TIN.

Bibliography: Report XV. Bulletin 67.

Tin is not at present produced in California; but during 1891–1892, there was some output from a small deposit near Corona, in Riverside County, as tabulated below. Small quantities of stream tin have been found in some of the placer workings in northern California, but never in paying amounts.

In 1916 two new occurrences were noted in northern San Diego County. Crystals of cassiterite were found there, associated with blue tourmaline crystals, amblygonite and beryl. No commercial quantity has been developed, only small pockets having been taken out, as yet; but the prospect is an interesting one.

The principal source of the world's supply of tin is the Straits Settlements on the Malay Peninsula, followed in second rank by Bolivia. Siam, Burma and Cornwall are also important sources. A measureable amount of the metal is also recovered by de-tinning scrap and old cans.

Total output of tin in California:

Year	Pounds	Value
1891	125,289	$27,564
1892	126,000	32,400
Totals	251,289	$59,964

TUNGSTEN.

Bibliography: Report on San Bernardino County, 1917; Report XV; Bulletins 38, 67. U. S. G. S. Bull. 652. Proc. Colo. Sci. Soc., Vol. XI.

The metal, tungsten, is used mainly in the steel industry and in the manufacture of electrical appliances, including the well-known tung-

sten filament lamps. Because of its resistance to corrosion by acids, it is valuable in making certain forms of chemical apparatus. Its employment in tool steel alloys, permits the operation of cutting tools, such as in lathe work, at a speed and temperature at which carbon steel would lose its temper—hence the name 'high-speed' steels for these tungsten alloys. As made in the United States, tungsten forms 13% to 20% of such steels. Some chromium, nickel, cobalt, or vanadium are sometimes also included.

Tungsten is introduced into the molten steel charge, either as the powdered metal or as ferro-tungsten (containing 50%–85% tungsten). The specific gravity of the pure metal, 19.3–21.4, is exceeded only by platinum, 21.5; iridium, 22.4; and osmium, 22.5. Its melting point is 3,267° C. (5,913° F.), being higher than any other known metal. Though millions of tungsten filament lamps are now made, the wires are so fine that the metal they contain represents but a few tons of tungsten concentrates annually.

Tungsten ore is produced in California principally in the Atolia-Randsburg district in San Bernardino and Kern counties, with small amounts coming from Nevada County and from the district near Goffs, in eastern San Bernardino. Most of the California tungsten ore is scheelite (calcium tungstate), though wolframite (iron-manganese tungstate) and hübnerite (manganese tungstate) also occur. The deposits at Atolia are the largest and most productive scheelite deposits known,[11] and the output has in some years equalled or exceeded that of ferberite (iron tungstate) from Boulder County, Colorado. It is interesting in this connection to note that, in practically all other tungsten producing districts of the world, wolframite is the important constituent. Burma, the largest producer, reports a yield of approximately 3,300 tons[12] of wolframite concentrates for 1917, most of which was obtained from placers, in part associated with cassiterite (tin oxide).

The value of the ore is based upon the content of tungstic trioxide (WO_3), and quotations are commonly made per unit (each 1%) of WO_3 present.

In California in 1917 there were marketed 2,466 tons of high-grade ore and concentrates, valued at $3,079,013, which is an increase of 196 tons in quantity, but a decrease of 33⅓% in value, as compared with the 1916 output. The decreased value is due to the lower market prices prevailing during 1917, the average being about $20 per unit, as against an average of nearly $40 in 1916. The tonnages here shown are re-calculated to a basis of 60% WO_3, the materials reported varying from ore assaying 2% to concentrates running as high as 75%. Most of the concentrates ranged about 63%. Previous to 1915, a single company

[11] U. S. G. S., Bull. 652, p. 32.
[12] U. S. Commerce Reports, No. 167, July 18, 1918.

produced almost all of California's tungsten. During the latter part of 1915, and the early months of 1916, because of the high prices prevailing, prospecting was much stimulated, and the known tungsten-bearing areas have been considerably extended both in San Bernardino and Kern counties. Some shipments have been made from mines opened up in the Clark Mountain and New York Mountains districts in eastern San Bernardino County. In these latter areas, wolframite and hübnerite are the principal ores, with some scheelite, while at Atolia it is scheelite only. Scheelite ore is also being extracted in Inyo County near Bishop, and three concentrating mills are in operation there. The Nevada County ore is also scheelite.

Distribution of the 1917 output was as follows:

County	Tons	Value
Kern	49	$58,148
San Bernardino	1,943	2,447,726
Inyo and Nevada*	474	573,139
Totals	2,466	$3,079,013

*Combined to conceal output of a single mine in Nevada County.

The annual value of tungsten produced in California since the inception of the industry is given herewith:

Year	Tons at 60% WO_3	Value	Year	Tons at 60% WO_3	Value
1905		$18,800	1913		$234,673
1906		189,100	1914		180,575
1907		120,587	1915	962	1,005,467
1908		37,750	1916	2,270	4,571,521
1909		190,500	1917	2,466	3,079,013
1910		208,245			
1911		127,706	Total value		$10,169,937
1912		206,000			

VANADIUM.

Bibliography: Report XV. Bulletin 67. Proc. Colo. Sci. Soc., Vol. XI. U. S. Bur. of Mines, Bulletin 104.

No commercial production of vanadium has as yet been made in California. Occurrences of this metal have been found at Camp Signal, near Goffs in San Bernardino County, and two companies have done considerable development work in the endeavor to open up paying quantities. Each had a mill under construction, in 1916, but apparently no commercial output was made. Ore carrying the mineral cuprodescloizite and reported as assaying 4% V_2O_5 was opened up. Late in 1917, some ore carrying vanadium was discovered in the 29

Palms, or Washington district on the line between Riverside and San Bernardino counties. It is stated that a concentrating plant will be built. There is a growing demand for vanadium, for use in the steel industry.

Quotations on the basis of vanadic acid are misleading. Present prices range around $4–$5 per pound of vanadium contained in ferro-vanadium. The cost of recovery is high. The association of copper is very detrimental.

ZINC.

Bibliography: Report XIV, XV. Bulletins 38, 67.

During 1917, zinc was produced mainly in Shasta, Inyo and San Bernardino counties to the amount of 11,854,804 pounds, valued at $1,209,190. This is a material decrease both in tonnage and value from the previous year, due to the lower prices prevailing. The average price for the year was 10.2¢ per pound as compared to 5.1¢ during 1914; 14.2¢ in 1915; and 13.4¢ in 1916.

The zinc ores of Shasta County are associated with copper, while those of Inyo and San Bernardino are associated mainly with lead—silver ores. The ores were mainly shipped to eastern smelters for treatment. The electrolytic zinc plant of the Mammoth Copper Co. at Kennett with a capacity of 100 tons of spelter per month has been in operation since July, 1917. The experimental electrolytic plant at the Bully Hill copper mine is now stated to be in operation.

The production, by counties, was as follows:

County	Pounds	Value
Inyo	3,525,004	$359,550
San Bernardino	38,735	3,951
Shasta	8,281,516	844,715
Amador and Calaveras*	9,549	974
Totals	11,854,804	$1,209,190

*Combined to conceal output of a single mine in each.

Total figures for zinc output of the state are as follows:

Year	Pounds	Value	Year	Pounds	Value
1906	206,000	$12,566	1913	1,157,947	$64,845
1907	177,759	10,598	1914	399,641	20,381
1908	54,000	3,544	1915	13,043,411	1,617,383
1909	----------	----------	1916	15,950,565	2,137,375
1910	----------	----------	1917	11,854,804	1,209,190
1911	2,679,842	152,751			
1912	4,331,391	298,866	Totals	49,855,360	$5,527,499

CHAPTER FOUR.

STRUCTURAL MATERIALS.

As indicated by this chapter heading, the mineral substances herein considered are those more or less directly used in building and structural work. California is independent, so far as these are concerned, and almost any reasonable construction can be made with materials produced in the state. This branch of the mineral industry for 1917 was valued at $17,440,276, as compared with a total value of $15,560,445 for the year 1916. Only a few years ago its value was of but small significance in considering the total mineral production of the state. With the growth, in population and otherwise, of California, this subdivision of the mineral industry will increase indefinitely. Deposits of granite, marble and other building stones are distributed widely throughout this area, and slowly but surely transportation and other facilities are being extended so that the growing demand may be met. The largest single item, cement, has had an interesting record of growth since the inception of the industry in California about 1891. Not until 1904 did the annual value of cement produced reach the million-dollar mark, following which it increased 500% in nine years; though since 1913 it has fallen slightly below its high-level mark.

Crushed rock production is yearly becoming more worthy of consideration, due to the strides recently taken in the use of concrete, as well as to activity in the building of good roads. Brick, with an annual output worth approximately $2,000,000, has slowly decreased, due to the popularity of cement and concrete; nevertheless, this item will be an important one for many years to come, and of course, a market for fire and fancy brick of all kinds will never be lacking.

Fifty-four counties contributed to this structural total for 1916, and there is not a county in the state which is not capable of some output of at least one of the materials under this classification.

Except for construction work directly connected with war activities, much of which is of only a temporary nature, the general building situation showed a decline in 1917 from previous years. This was due to the war's demands, priority freight schedules, and the request of the Government to defer all but urgent construction for the period of the war.

The following table gives the comparative figures for the value of structural materials produced in California during the years 1916 and 1917:

Substance	1916		1917		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Bituminous rock	19,449 tons	$63,561	5,590 tons	$18,580	$47,981—
Brick and tile	206,960 M.	2,036,570		2,532,721	436,151+
Cement	5,299,507 bbls.	6,210,293	5,790,734 bbls.	7,544,282	1,333,989+
Chromite	48,943 tons	717,244	52,379 tons	1,130,298	413,054+
Granite		535,339		221,997	313,342—
Lime	493,635 bbls.	390,475	500,730 bbls.	311,380	79,095—
Magnesite	154,052 tons	1,311,893	209,648 tons	1,976,227	664,334+
Marble	25,954 cu. ft.	50,280	24,755 cu. ft.	62,950	12,670+
Sandstone	17,270 cu. ft.	10,271	31,090 cu. ft.	7,074	3,197—
Miscellaneous stone		4,171,519		3,634,767	536,752—
Totals		$15,560,445		$17,440,276	
Net increase					$1,879,831+

ASPHALT.

Bibliography: State Mineralogist Reports VII, X, XII, XIII, XIV. Bulletins 16, 32.

Asphalt was for a number of years accounted for in reports by the State Mining Bureau, because in the early days of the oil industry, considerable asphalt was produced from outcroppings of oil sand, and was a separate industry from the production of oil itself. However, at the present time most of the asphalt comes from the oil refineries, which produce a better and more uniform grade; hence, its value is not now included in the mineral total, as to do so would be a partial duplication of the crude petroleum figures. Such natural asphalt as is at present mined is in the form of bituminous sandstones, and is recorded under that designation.

According to the U. S. Geological Survey, the war has stimulated activity in the domestic markets for asphaltic materials derived from crude petroleum and for imported asphalt, but relative abundance and adaptability of those materials has lessened the demand for the native bitumens and for the various types of bituminous rock produced in this country.

The production of refinery asphalt from 14 refineries during 1917 was approximately 220,300 tons, valued at $2,100,252; as compared with 258,000 tons, worth $1,959,000 for 1916. California leads all other states of the Union in such production, as her crude oils are almost entirely of asphaltic base.

BITUMINOUS ROCK.

Bibliography: State Mineralogist Reports XII, XIII, XV.

Bituminous rock is used in a number of places, principally for road dressing; but the manufacture of asphalt at the oil refineries has almost eliminated the industry of mining bituminous rock. The production during 1917 from one quarry each in Santa Cruz and San Luis Obispo counties was 5,590 tons, valued at $18,580, compared with 19,449 tons and 66,561 in 1916.

The following tabulation shows the total amount and value of bituminous rock quarried and sold in California, from the records compiled by the State Mining Bureau, annually since 1887:

Year	Tons	Value	Year	Tons	Value
1887	36,000	$160,000	1904	45,280	$175,680
1888	50,000	257,000	1905	24,753	60,436
1889	40,000	170,000	1906	16,077	45,204
1890	40,000	170,000	1907	24,122	72,835
1891	39,962	154,164	1908	30,718	109,818
1892	24,000	72,000	1909	34,123	116,436
1893	32,000	192,036	1910	87,547	165,711
1894	31,214	115,193	1911	75,125	117,279
1895	38,921	121,586	1912	44,073	87,467
1896	49,456	122,500	1913	37,541	78,479
1897	45,470	128,173	1914	66,119	166,618
1898	46,836	137,575	1915	17,789	61,468
1899	40,321	116,097	1916	19,449	66,561
1900	25,306	71,495	1917	5,590	18,580
1901	24,052	66,354			
1902	33,490	43,411	Totals	1,147,278	$3,493,262
1903	21,944	53,106			

BRICK and TILE.

Bibliography: Reports XIV, XV. Bulletin 38.

As would be expected in a state with diversified and widespread mineral resources, a great variety of brick is annually produced in California, including common, fire, pressed, glazed, sand-lime, and others. As far as possible the different kinds have been segregated in the following tabulation. We also include under this heading the various forms of hollow building 'tile' or blocks, instead of under industrial pottery clays as in the reports previous to 1915.

The detailed figures of brick production for 1917, by counties, are given in the following tabulation:

Brick Production for 1916, by Counties.

County	Common		Fire		Glazed, pressed, fancy, vitrified		Building tile		Total value
	Amount, M.	Value	Amount, M.	Value	Amount, M.	Value	Tons	Value	
Alameda	11,385	$99,632			4,403	$122,765			$222,397
Amador			3,761	$95,345					95,345
Contra Costa	15,149	135,092			1,818	31,635			166,727
Kern	3,011	22,785							22,785
Los Angeles	63,152	458,109	5,347	198,271	†6,336	162,344	12,506	120,357	939,081
Orange	1,400	11,000							11,000
Riverside	846	8,317	6,409	144,949	439	9,617			162,883
San Diego	1,570	12,669							12,669
Santa Clara	14,000	80,000							80,000
Tulare	6,771	112,938							112,938
Fresno, Humboldt, Imperial, Marin, Mendocino, Sacramento, San Bernardino, San Joaquin, San Luis Obispo, Santa Barbara, Shasta, Ventura*	37,812	300,561							
Alameda, Contra Costa, Placer, San Joaquin, San Luis Obispo*			7,191	223,530					
Placer, Sacramento, San Mateo*					1,469	45,670			
Alameda, Imperial, Placer, Riverside, Sacramento, San Diego, San Mateo, Santa Clara, Tulare*							16,842	137,135	706,896
Totals	155,096	$1,241,103	22,708	$662,095	14,465	$372,031	29,348	$257,492	$2,532,721

*Combined to conceal output of a single producer in each.
†Includes 'rug' brick; also radial sewer brick; hollow brick; sewer block; 'bituminized blocks.'

Record of brick production in the state has been kept since 1893 by this Bureau, the figures for building tile being also included since 1914. The annual and total figures, for amount and value, are given in the following table:

Year	Thousands	Value	Year	Thousands	Value
1893	103,900	$801,750	1907	362,167	$3,438,951
1894	81,675	457,125	1908	332,872	2,506,495
1895	131,772	672,360	1909	333,846	3,059,929
1896	24,000	524,740	1910	340,883	2,934,731
1897	97,468	563,240	1911	327,474	2,638,121
1898	100,102	571,362	1912	337,233	2,940,290
1899	125,950	754,730	1913	358,754	2,915,350
1900	137,191	905,210	1914	270,791	2,288,227
1901	130,766	860,488	1915	180,538	1,678,756
1902	169,851	1,306,215	1916	206,960	2,096,570
1903	214,403	1,999,546	1917		2,532,721
1904	281,750	1,994,740			
1905	286,618	2,273,786	Total		$45,254,281
1906	277,762	2,538,848			

CEMENT.

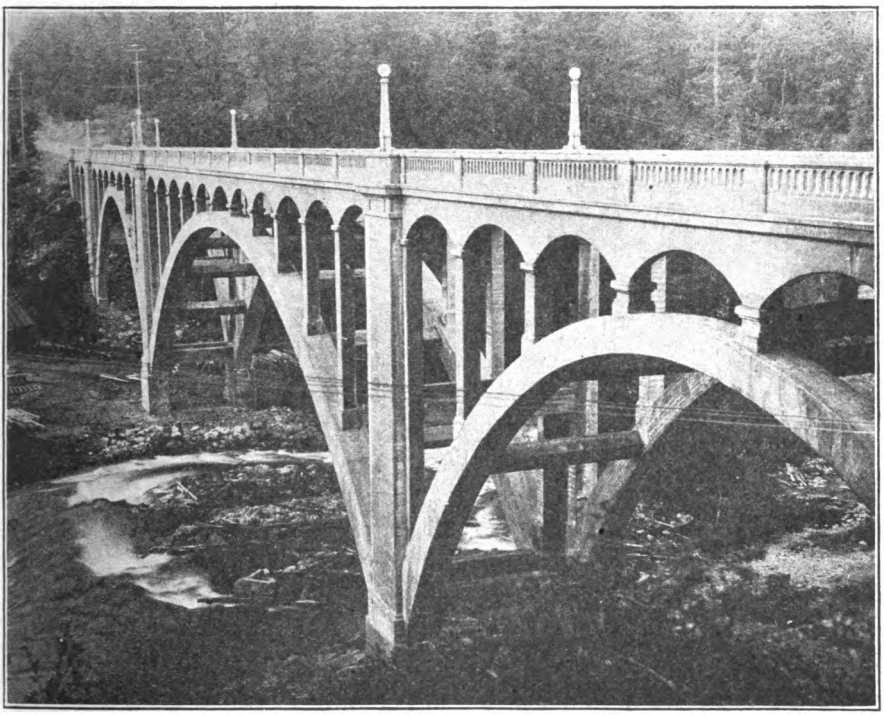
Bibliography: State Mineralogist Reports VIII, IX, XII, XIV, XV. Bulletin 38.

Cement is one of the most important structural materials in the output of the state. During 1917 there was produced a total of 5,790,734 barrels, valued at $7,544,282, being an increase both in quantity and value over the 1916 figures. This output comes from eight operating plants in six counties, employing approximately 2,420 men. The enlargement of this industry, of course, depends upon the growth of surrounding communities, and a summary of the lime and clay deposits of the state shows that so far as raw materials are concerned enlargement is possible.

The cement industry is so centralized that it is not possible to apportion the production to the counties in which plants are located without making private business public. With the exception of San Bernardino, no county has more than one cement plant, The three operating plants in San Bernardino County, in 1917, made a total of 1,323,931 barrels, valued at $1,672,054; the balance coming from a single plant in each of the following counties: Contra Costa, Kern, Napa, Riverside, Santa Cruz and Solano.

'Portland' cement was first commercially produced in the state in 1891; though in 1860 and for several years following, a natural hydraulic cement from Benicia was utilized in building operations in San Francisco. While the total figures are not of the same magnitude

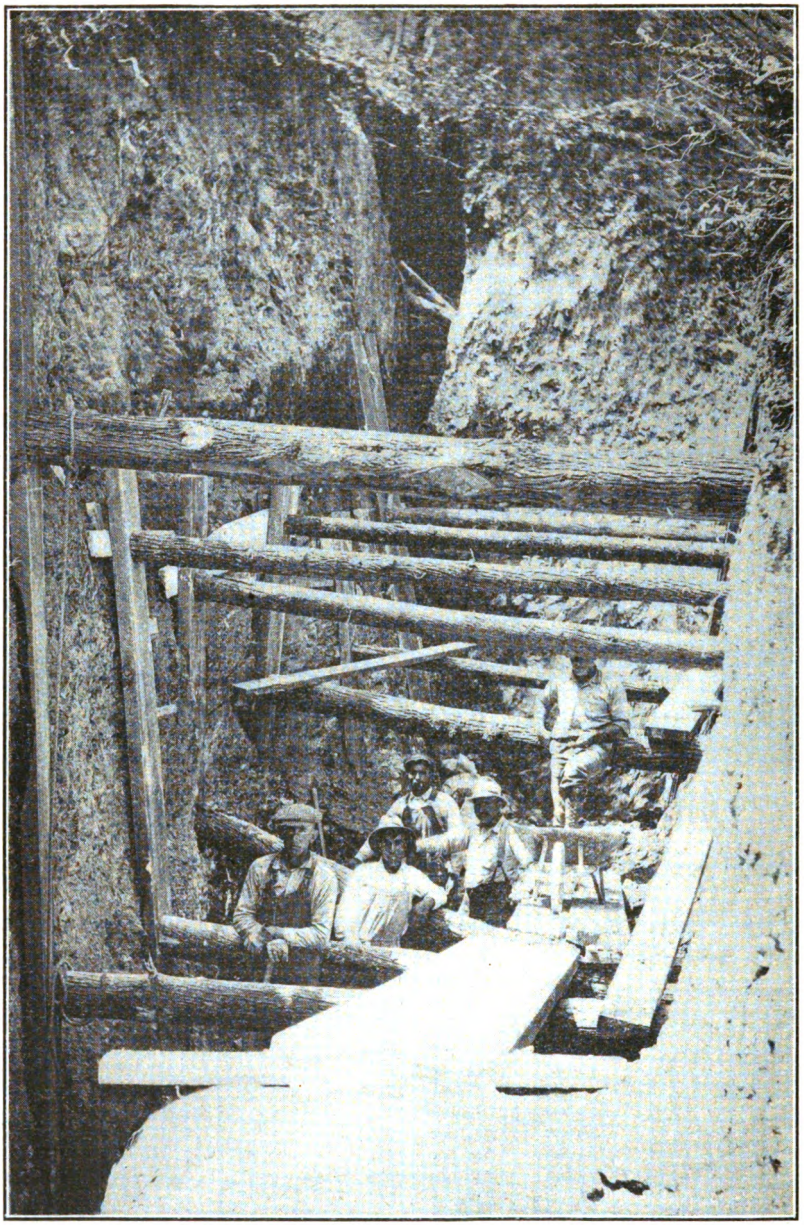
as those for gold and petroleum, the growth of the industry has been more than rapid, and a comparison of the annual figures representing the output since the inception of the industry is of interest.



State Highway Bridge over the Sacramento River at Dunsmuir, showing use of California cement and crushed rock in a reinforced concrete structure.

Annual production of cement in California has been as follows:

Year	Barrels	Value	Year	Barrels	Value
1891	5,000	$15,000	1906	1,286,000	$1,941,250
1892	5,000	15,000	1907	1,613,563	2.585.577
1893			1908	1,629,615	2,359,692
1894	8,000	21,600	1909	3,779,205	4,969,437
1895	16,383	32,556	1910	5,453,193	7,485,715
1896	9,500	28,250	1911	6,371,369	9,085,625
1897	18,000	66,000	1912	6,198,634	6,074,661
1898	50,000	150,000	1913	6,167,806	7,743,024
1899	60,000	180,000	1914	5,109,218	6,558,148
1900	52,000	121,000	1915	4,918,275	6,044,950
1901	71,800	159,842	1916	5,299,507	6,210,293
1902	171,000	423,600	1917	5,790,734	7,544,282
1903	640,868	968,727			
1904	969,538	1,539,807			
1905	1,265,553	1,791,916	Totals	56,959,761	$74,115,952



Mining chromite near Camp Meeker, Sonoma County. Photo by C. J. Lyser.

CHROMITE.

Bibliography: State Mineralogist Reports IV, XII, XIII, XIV, XV; Bulletins 38, 76. Preliminary Report 3. U. S. G. S., Bull. 430. Min. & Sci. Press, Vol. 114, p. 552.

Chromic iron ore, or chromite, to the amount of 52,379 short tons valued at $1,130,298 f. o. b. shipping point was mined and shipped in California during the year 1917. This is an increase both in quantity and total value over 1916, which showed 48,948 tons worth $717,244. Chromite is widely distributed in this state, the 1917 output coming from 25 counties, the larger amounts being credited to El Dorado, Fresno, Butte, Placer, San Luis Obispo and Shasta in the order named.

Economic Conditions.

Chromite is one of several of California's minerals most affected by the economic conditions brought about by the European war. The major portion of our domestic requirements for chrome is for consumption in the steel mills of the East. Formerly, most of that used was imported from Rhodesia and New Caledonia, and they are still the more important sources. The reports of the U. S. Department of Commerce, show the foreign imports of chromic iron for the four years 1913–1917 (inc.) to have been 49,772; 74,455; 115,886 and 72,063 long tons, respectively. Similarly to conditions discussed herein under manganese (see *ante*), the increased demand for steel products has also increased the necessity for chromite as a refractory and for the preparation of ferro-chrome. Our own domestic sources are supplying a part of the increased demand, and some tonnage is coming from Canada.

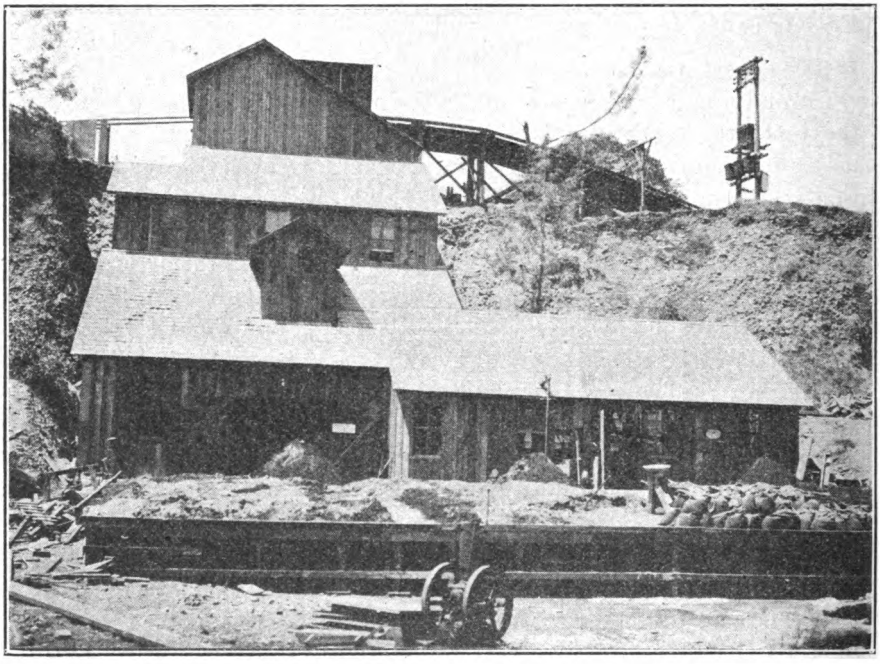
According to Dolbear,[13] "to be readily salable chrome ore should contain at least 40% chromic oxide (Cr_2O_3) and less than 8% silica (SiO_2). Some ore is sold which carries not more than 30% Cr_2O_3; sometimes SiO_2 as high as 10% to 15% is permitted. Ore containing 40% Cr_2O_3 is more satisfactory in fire-brick manufacture than 30% or 50% ore. When other grades are purchased they are sometimes crushed and mixed with higher or lower grades, as may be required, to secure a 40% product."

The most recent available publications on Chromite are: Preliminary Report No. 3, of the State Mining Bureau, and an excellent and timely pamphlet by Burch and Dolbear[14]. They give valuable data relative to the occurrence and concentration of chrome ore, also markets and consumers. A complete and detailed report, designated as Bulletin No. 76, of the State Mining Bureau, is now in press.

[13]Dolbear, S. H., Min. & Sci. Press, Apr. 21, 1917, p. 554.
[14]Burch, Albert, and Dolbear, S. H., Chromite: publ. July 1, 1918, by the Mining & Scientific Press, San Francisco.

Occurrence.

Until 1916, when some shipments were made from Oregon and smaller amounts from Maryland, Wyoming and Washington, practically our only domestic production of chromite for many years came from California. From 1828 to 1860, the deposits in Pennsylvania and Maryland supplied the world's consumption. There are two main belts in California yielding this mineral—one, along the Coast Ranges from San Luis Obispo County to the Oregon line, including Klamath Mountains at the north end, and the other in the Sierra Nevada from Tulare County to Plumas County. Chromite occurs as lenses in basic igneous



Chromite concentrating mill of Placer Chrome Company, at Rattlesnake Bar, El Dorado County.

rocks such as peridotite and pyroxenite, and in serpentine which has been derived by alteration of such basic rocks. For the most part, so far as developments have yet shown, the lenses have proven to be small, relatively few of them yielding over 100 tons apiece. A notable exception to this was the deposit on Little Castle Creek near Dunsmuir, from which upwards of 15,000 tons were shipped before it was exhausted. Deposits now being worked in Del Norte County promise well for a large tonnage, according to recent developments. On the whole the ore bodies in the northwestern corner of the state appear to average larger in size than the chromite lenses in other parts of California.

Concentration is now an accomplished fact in several localities, thus utilizing some of the disseminated and lower-grade orebodies which have been found. In fact, it looks as if an important part of our future production is going to come from this source.

The major consumption of chromic iron ore is for its use as a refractory lining in smelting furnaces for steel and copper. A smaller portion is used in the preparation of ferro-chrome for chrome-steel alloys. Some of the California product in 1916–1917 was converted into ferro-chrome in the electric furnaces of the Noble Electric Steel Company at Heroult, Cal., and some of it was similarly reduced in electric furnaces at Niagara Falls, N. Y. A small amount of high-grade ore was utilized in preparation of chromates for tanning.

Prices and Production.

During 1917, the prices in California on the basis of 40% chromic oxide ranged from $20–$30 per ton f. o. b., with a premium for higher grades and deductions for lower. The producers' reports to the State Mining Bureau indicate an average of approximately $21.60 per ton received for all grades for the year as against $14.65 in 1916. Present quotations (July, 1918) range from $1.25 per unit for 38% ore, to $1.50 per unit for 48% and upwards, f. o. b. California points. For the Eastern buyer, to these prices must be added freight charges of $11–$16 per ton.

The distribution of the 1917 product, by counties, was as follows:

County	Tons	Value	County	Tons	Value
Alameda	52	$960	Santa Clara	334	$8,515
Amador	65	1,420	Shasta	3,116	68,479
Butte	5,746	104,085	Siskiyou	2,046	49,797
Calaveras	1,613	34,245	Sonoma	226	6,200
Del Norte	3,275	97,255	Stanislaus	1,438	29,240
El Dorado	8,319	167,950	Tehama	2,053	41,646
Fresno	6,289	109,292	Trinity	242	6,325
Glenn	879	21,474	Tulare	450	11,000
Lake	1,466	36,326	Tuolumne	2,680	54,290
Napa	844	22,020	Mendocino and San Benito*	415	8,300
Nevada	1,962	43,449			
Placer	4,287	105,384			
Plumas	473	9,800			
San Luis Obispo	4,109	92,846	Totals	52,379	$1,130,298

*Combined to conceal output of a single mine in each.

The annual output of chromite since 1887 has been as follows:

Year	Tons	Value	Year	Tons	Value
1887	3,000	$40,000	1904	123	$1,845
1888	1,500	20,000	1905	40	600
1889	2,000	30,000	1906	317	2,859
1890	3,599	53,985	1907	302	6,040
1891	1,372	20,580	1908	350	6,195
1892	1,500	22,500	1909	436	5,309
1893	3,319	49,785	1910	749	9,707
1894	3,680	39,980	1911	935	14,197
1895	1,740	16,795	1912	1,270	11,260
1896	786	7,775	1913	1,180	12,700
1897			1914	1,517	9,434
1898			1915	3,725	38,044
1899			1916	48,943	717,244
1900	140	1,400	1917	52,379	1,130,298
1901	130	1,950			
1902	315	4,725			
1903	150	2,250	Totals	135,497	$2,277,557

GRANITE.

Bibliography: State Mineralogist Reports X, XII, XIII, XIV, XV; Bulletin 38.

In the reports for several years previous to 1916 granite was treated in a subdivision under 'Stone Industry' or under 'Miscellaneous Stone.' We have since rearranged the subjects, somewhat, and now give granite a separate heading, as had previously been done with marble and sandstone. Crushed rock and paving blocks derived from granite quarries are continued under the heading of 'Miscellaneous Stone.'

The output of granite, particularly for building and ornamental purposes, shows a falling off since 1914 from earlier annual amounts. In 1915, this was due mainly to a strike of the granite cutters which covered practically all of the last half of the year. That granite is not used more is probably due to its greater cost as compared to concrete and ornamental brick and tile for building. In 1916, the San Francisco City Hall and the Sub-Treasury Building having been completed, the only other large public buildings under construction utilizing granite were two on the campus of the University of California in Berkeley. In 1917, there were no new large pieces of work undertaken.

California building granites, particularly the varieties from Raymond, Madera County, and Rocklin, Placer County, are unexcelled by any similar stone found elsewhere.

Granites of excellent quality for building and monumental purposes are also quarried in Riverside and San Diego counties. The Fresno County stone is a dark, hornblende diorite, locally called 'black granite,' whose color permits of a fine contrast of polished and un-

polished surfaces, making it particularly suitable for monumental and decorative purposes.

In so far as it has been possible to do so, granite production has been segregated in the following table into the various uses to which the product was put. It will be noted, however, that a portion of the output has been entered under the heading 'Unclassified.' This is necessary because of the fact that some of the producers have no way of telling to what specific use their stone was put after they had quarried and sold the same.

The distribution of the 1917 product, by counties, was as follows:

Granite Production, by Counties, for 1916.

County	Building stone		Monumental		Curbing		Unclassified		Total value
	Cubic feet	Value	Cubic feet	Value	Linear feet	Value	Cubic feet	Value	
Fresno			9,000	$31,500					$31,500
Placer	9,618	$7,662	4,338	6,949	25,656	$15,781			30,392
Riverside	4,325	2,170	941	1,041			500	$250	3,461
San Bernardino					5,000	500	†13,300	1,850	2,350
Siskiyou							1,000	500	500
Madera, Plumas, San Diego, Tulare*	25,600	87,975	28,315	33,169	14,500	8,600	48,075	24,050	153,794
Totals	39,543	$97,807	42,594	$72,659	45,156	$24,881	62,875	$26,650	$221,997

*Combined to conceal output of a single operator in each.
†Includes a stone used for a cement-kiln liner.

The value of granite produced, annually since 1887, has been as follows:

Year	Value	Year	Value
1887	$150,000	1904	$467,472
1888	57,000	1905	353,837
1889	1,329,018	1906	344,083
1890	1,200,000	1907	373,376
1891	1,300,000	1908	512,923
1892	1,000,000	1909	376,834
1893	531,322	1910	417,898
1894	228,816	1911	355,742
1895	224,329	1912	362,975
1896	201,004	1913	981,277
1897	188,024	1914	628,786
1898	147,732	1915	227,928
1899	141,070	1916	535,339
1900	295,772	1917	221,997
1901	519,285		
1902	255,239	Total	$14,607,748
1903	678,670		

LIME.

Bibliography: Bulletin 38.

Lime to the amount of 500,730 barrels, valued at $311,380, was produced from eight counties during 1917, as compared with 493,635 barrels, valued at $390,475, in 1916. This figure includes only such lime as is used in building operations. That utilized in sugar making, for smelter flux, and as a fertilizer are classified under 'Industrial Materials.' That consumed in cement manufacture is included in the value of cement.

Distribution, by counties, is shown in the following table:

County	Barrels	Value
Santa Cruz	213,104	$173,778
Alameda, El Dorado, Kern, San Bernardino, Shasta, Siskiyou, Tuolumne*	287,626	137,602
Totals	500,730	$311,380

*Combined to conceal output of a single operator in each.
For table of production by years, see under 'industrial' limestone.

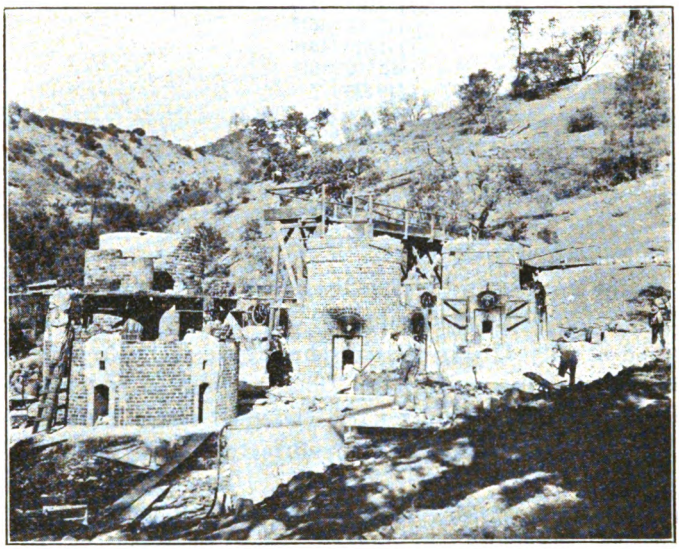
MAGNESITE.

Bibliography: State Mineralogist Reports XII, XIII, XIV, XV; Bulletin 38. U. S. G. S. Bulletins 355, 540. Min & Sci. Press, Vol. 114, p. 237.

Magnesite has for a number of years been known to exist in many localities in California. In quality it is very high grade, many deposits yielding material carrying above 95% magnesium carbonate. The de-

posits are mostly in the metamorphic rocks of the Coast Range and Sierra Nevada Mountains, and are scattered over an area nearly four hundred miles long. One deposit of sedimentary origin is situated in the Mojave Desert region, in Kern County. Up to the end of 1916, California was the only state, of record, in the United States, producing magnesite in commercial quantities. In 1917, Washington entered the active list.

During the year 1917, the activity begun in 1915 not only continued but was increased even over the record output of 1916, so that California's output was raised from the 30,721 tons worth $283,461 in 1915, to 154,052 tons worth $1,311,893 in 1916, and to 209,648 tons valued at



Calcining furnaces at the Sampson Magnesite Mine, San Benito County.

$1,976,227 in 1917. The great activity in the steel industry has called for a much larger tonnage of refractories, such as magnesite and chromite, for furnace linings. The complete shutting off of the Austrian supplies, and transportation difficulties interfering with importations from Greece, has caused the Eastern steel operators to look to California for magnesite. How well we have responded is shown by the figures given above. The permanent nature of the improvements and development work at some of the deposits gives promise that future production will continue important for some years yet, at least.

During the height of the summer shipping-season, in July, prices reached a figure of $12.50 per ton, f. o. b. rail, for California crude magnesite. Before the close of the year, however, the market broke, due in part to freight-car embargoes and priority classifications, and to

the competition of the new Washington deposits. The Washington magnesite appears to contain more iron than most of the California mineral, which makes it desirable for the steel operators. However, the experiences of the past two years have proven that several California localities have sufficient iron in their magnesite to be serviceable in the steel furnaces. This is particularly true of the Refractory Magnesite Company's mine in Sonoma County, and the White Rock Mine in Napa County. A recent (August, 1918) press bulletin of the U. S. Geological Survey indicates that the 1918 magnesite output of California may be reduced as much as 50% from the 1917 figures, on account of the Washington and Canadian competition.

Producing Districts.

The Porterville district in Tulare County continues to be the most important in the state. The Tulare Mining Company, for some years the largest single producer, was passed in 1916 by the Porterville Magnesite Company. The magnesite is stoped in underground workings, and calcined in two vertical shaft kilns. A railroad spur runs direct to the furnaces. The Porterville Magnesite Company both stopes and quarries its ore. They have two rotary kilns, and in 1917 shipped about half of their product calcined. The Lindsay Mining Company shipped the crude ore direct. This property adjoins the Tulare Company, to whom it was sold late in 1917. The custom calcining plant of the American Magnesite Company at Porterville, has two rotary kilns in operation. There are several other and smaller operators in Tulare County, all shipping crude.

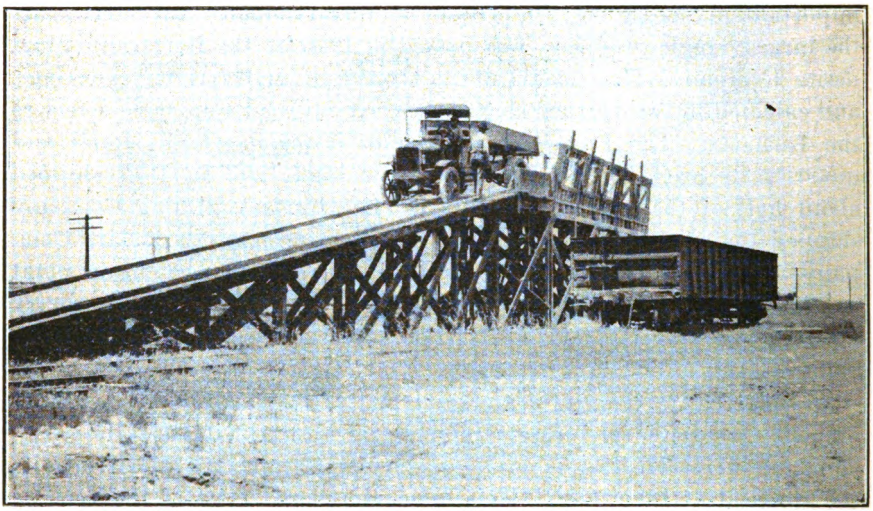
In Santa Clara County, in the mine of the Western Magnesite Development Co. at Red Mountain, the material is stoped underground, calcined in two vertical kilns, and transported 33 miles by auto trucks to the railroad at Livermore. This mine was closed most of the year on account of litigation. The adjoining property of the Pacific Magnesite Company also made shipments. The Sherlock mine and others near Madrone made some shipments in 1917 of crude ore. Some new mines were also opened up in the Red Mountain district.

The Sonoma Magnesite Company near Cazadero, Sonoma County, extracted its ore both by stope and quarry and has added a second rotary kiln to its equipment. Shipments of both raw and calcined ore were made, the former to steel mills and the latter to the plastic trade. The Refractory Magnesite Company at Preston has an ore which is an isomorphous mixture of magnesite and ferrous carbonate, and burns brown, carrying up to 6% Fe_2O_3. When calcined it resembles the Austrian 'spaeder,' particularly desired by the steel men. A vertical kiln is in operation. The product, all of which is dead-burned, is hauled two miles down a rather steep road to the railroad, and made

into refractory brick at a plant in Stockton. Shipments of crude ore were made from several smaller properties in Sonoma County during the year.

Some ore was shipped from the sedimentary deposit at Bissell, in Kern County, and calcined in rotary kilns at Los Angeles before shipment East. Production, also, was resumed at Winchester in Riverside County.

In Napa County a considerable tonnage was shipped, both crude and calcined, from the White Rock mine in Pope Valley, also from the property of the Tulare Mining Company and one or two others near Rutherford. The White Rock has 11 vertical kilns in operation, six of which were added in 1917; and there is a customs plant with two vertical kilns in operation at Rutherford.



Magnesite loading-bunkers at Ingomar, California.

An important tonnage was produced in 1917 from the Ward and the old Fresno Magnesite Company properties at Piedra in Fresno County, and from the Sampson Peak group in San Benito County. At the latter, three vertical kilns were built and put in operation. The entire product is calcined, and hauled in motor trucks about 40 miles to the railroad at Mendota.

In addition to the above-mentioned, some production was made in 1917 in Alameda County at Cedar Mountain; in Mendocino County; and from the Red Mountain district in Stanislaus County.

One of the interesting developments of the year, was the opening up of a new mine in Stanislaus County, west of Ingomar, near the Merced County line. The magnesite there found proved to be of unusually high grade, some being shipped which carried a total of less than 1% of impurities. The General Electric Company bought some of this

ore at a figure much over the prevailing market price, and shipped it to its works at Schenectady, N. Y. They utilized a part in the preparation of magnesium metal by electric-furnace reduction, and a part as an insulating powder for certain electrical installations.

Uses.

The principal uses at the present time include: refractory linings for basic open-hearth steel furnaces, copper reverberatories and converters, bullion and other metallurgical furnaces; in the manufacture of paper from wood pulp; and in structural work, for flooring, wainscoting, tiling, sanitary kitchen and hospital finishing, etc. In connection with building work it has proven particularly efficient as a flooring for steel railroad coaches, on account of having greater elasticity and resilience than 'Portland' cement. For refractory purposes, the magnesite is 'dead-burned'—*i. e.*, all or practically all of the CO_2 is expelled from it. For cement purposes, it is left 'caustic'—*i. e.*, from 5% to 10% of CO_2 is retained. When dry caustic magnesite is mixed with a solution of magnesium chloride ($MgCl_2$) in proper proportions, a very strong cement is produced, known as oxychloride or Sorel cement. It is applied in a plastic form, which sets in a few hours as a tough, seamless surface.

It is stated that some metallic magnesium is at present being prepared electrolytically at Niagara Falls, from magnesite (see also Magnesium Chloride, under Salines, *post*).

Output and Value.

In considering mineral production the value of the crude material is used as far as practicable. Magnesite presents a peculiar example of a material which previous to the present activity was seldom handled on the market in the crude state. It is ordinarily calcined and ground before being considered marketable. The value of the calcined magnesite varies, the San Francisco price for 1917 ranging from $35 to $55 per ton, which figure includes about $4 per ton freight. From 2 to 2½ tons of the crude material are mined to make one ton of the calcined. In the earlier reports the foregoing circumstances were used in calculating an arbitrary value for the crude material at the mine, there having been very little product shipped crude. On a similar basis, the value of the 1917 crude would have been approximately $20 per ton. On the contrary, however, considerable tonnages were in 1916 and 1917 shipped in the crude state, contracted for at prices ranging from $7 to $10 per ton, f. o. b. rail points, or an average of about $9.50 per ton, for 1917.

Magnesite products have been found to be highly satisfactory and are growing in popularity, and the future for this industry appears to be good. A large supply is now known to exist in California and only a

sufficient demand and cheaper transportation are lacking to make this an item of continued consequence in the mineral total of the state.

Production of crude magnesite for 1917, by counties, is given in the following table, with total crude value:

County	Tons	Value
Fresno	6,077	$57,422
Napa	40,329	387,980
Santa Clara	9,963	99,287
Sonoma	5,636	61,335
Stanislaus	3,196	44,350
Tulare	136,562	1,238,853
Alameda, Kern, Mendocino, Placer, Riverside, San Benito, Tuolumne*	7,885	87,050
Totals	209,648	$1,976,227

*Combined to conceal output of a single producer in each.

Approximately 40,000 tons were shipped calcined, representing a total of about 80,000 tons of crude ore.

Annual production for California, amount and value, since 1887, is shown in the following tabulation:

Year	Tons	Value	Year	Tons	Value
1887	600	$9,000	1904	2,850	$9,298
1888	600	9,000	1905	3,933	16,221
1889	600	9,000	1906	4,032	40,320
1890	600	9,000	1907	6,405	57,720
1891	1,500	15,000	1908	10,582	80,822
1892	1,500	15,000	1909	7,942	62,588
1893	1,093	10,930	1910	16,570	113,887
1894	1,440	10,240	1911	8,858	67,430
1895	2,200	17,000	1912	10,512	105,120
1896	1,500	11,000	1913	9,632	77,056
1897	1,143	13,671	1914	11,438	114,380
1898	1,263	19,075	1915	30,721	283,461
1899	1,280	18,480	1916	154,052	1,311,893
1900	2,252	19,333	1917	209,648	1,976,227
1901	4,726	43,057			
1902	2,830	20,655	Totals	513,663	$4,586,379
1903	1,361	20,515			

MARBLE.

Bibliography: State Mineralogist Reports XII, XIII, XIV; Bulletin 38. U. S. Bur. of M., Bull. 106.

Marble is widely distributed in California; and in a considerable variety of colors and grain. During 1917, the production amounted to 24,755 cubic feet, valued at $62,950, from Inyo and Tuolumne counties. This shows a slight decrease in amount but an increase in value over

the previous year, though still below what might be considered the normal output of former years, and certainly far below our possibilities.

The decrease in output of marble in recent years is probably due in part to the fact that foreign, eastern and Alaskan marbles are landed here by water cheaper than much of our local stone can be put on the market, on account of our higher labor costs and transportation difficulties, though California has many beautiful and serviceable varieties. It is also due in part to the general curtailment of building activity on account of the war conditions.

Data on annual production since 1887, as compiled by the State Mining Bureau, follows. Previous to 1894 no records of amount were preserved:

Year	Cubic feet	Value	Year	Cubic feet	Value
1887		$5,000	1904	55,401	$94,208
1888		5,000	1905	73,303	129,450
1889		87,030	1906	31,400	75,800
1890		80,000	1907	37,512	118,066
1891		100,000	1908	18,653	47,665
1892		115,000	1909	79,600	238,400
1893		40,000	1910	18,960	50,200
1894	38,441	98,326	1911	20,201	54,103
1895	14,864	56,566	1912	27,820	74,120
1896	7,889	32,415	1913	41,654	113,282
1897	4,102	7,280	1914	25,436	48,832
1898	8,050	23,594	1915	22,186	41,518
1899	9,682	10,550	1916	25,954	50,280
1900	4,108	5,891	1917	24,755	62,950
1901	2,945	4,630			
1902	19,305	37,616	Total value		$2,005,126
1903	84,624	97,354			

ONYX and TRAVERTINE.

Bibliography: State Mineralogist Reports XII, XIII, XIV; Bulletin 38.

Onyx and travertine are known to exist in a number of places in California, but there has been no production reported since the year 1896.

Production by years was as follows:

Year	Value	Year	Value
1887	$900	1893	$27,000
1888	900	1894	20,000
1889	900	1895	12,000
1890	1,500	1896	24,000
1891	2,400		
1892	1,800	Total	$91,400

SANDSTONE.

Bibliography: State Mineralogist Reports XII, XIII, XIV, XV; Bulletin 38. U. S. Bur. of M., Bull. 124.

An unlimited amount of high-grade sandstone is available in California, but the wide use of concrete in buildings of every character, as well as the popularity of a lighter colored building stone, has retarded this branch of the mineral industry very seriously during recent years. In 1917 four counties—Santa Barbara, Siskiyou, Sonoma and Ventura—turned out 31,090 cubic feet, valued at $7,074, which is considerably less than former years. The main feature of the loss the past three years is the closing of the well-known Colusa quarries, on account of the competition of lighter colored materials.

Amount and value, as far as contained in the records of this Bureau, are presented herewith, with total value from 1887 to date:

Year	Cubic feet	Value	Year	Cubic feet	Value
1887		$175,000	1904	363,487	$567,181
1888		150,000	1905	302,813	483,268
1889		175,598	1906	182,076	164,068
1890		100,000	1907	159,573	148,148
1891		100,000	1908	93,301	55,151
1892		50,000	1909	79,240	37,032
1893		26,314	1910	165,971	80,443
1894		113,592	1911	255,313	127,314
1895		35,373	1912	66,487	22,574
1896		28,379	1913	62,227	27,870
1897		24,086	1914	111,691	45,322
1898		46,384	1915	63,350	8,438
1899	56,264	103,384	1916	17,270	10,271
1900	378,468	254,140	1917	31,090	7,074
1901	266,741	192,132			
1902	212,123	142,506	Total value		$4,086,351
1903	353,002	585,309			

SERPENTINE.

Bibliography: Bulletin 38.

Serpentine has not been produced in California to a very large extent at any time. A single deposit, that on Santa Catalina Island, has yielded the principal output to date. Some material was shipped from there in 1917, being the first recorded since 1907. It was used for decorative building purposes and for electrical switchboards.

The following table shows the amount and value of serpentine from 1895 as recorded by this Bureau:

Year	Cubic feet	Value	Year	Cubic feet	Value
1895	4,000	$4,000	1903	99	$800
1896	1,500	6,000	1904	200	2,310
1897	2,500	2,500	1905	----------	----------
1898	750	3,000	1906	847	1,694
1899	500	2,000	1907	1,000	3,000
1900	350	2,000	1917	*	*
1901	89	890			
1902	512	5,065	Totals	12,347	$33,259

*Under Unapportioned.

SLATE.

Bibliography: Report XV, Bulletin 38.

Slate was first produced in California in 1889. Up to and including 1910 such production was continuous, there being none between that year and 1915. Many large deposits are known in the state, especially in El Dorado, Calaveras and Mariposa counties, but the demand has been light owing principally to competition of cheaper roofing materials.

The property of the Eureka Slate Company in El Dorado County was in 1916 taken over by the Sierra Slate Corporation of New York, and, it is stated, will again be operated. This will be the only quarry producing roofing slate, commercially, west of Pennsylvania. This Eureka roofing slate has been passed upon as one of three brands acceptable on Federal work, the other two being from Maine and Pennsylvania, respectively.

A square of roofing slate is a sufficient number of pieces of any size to cover 100 square feet of roof, with allowance generally for a three-inch lap. The size of the pieces of slate making up a square ranges from 7 x 9 inches to 16 x 24 inches, and the number of pieces in a square ranges from 85 to 686; and it is worth $3.50 to $10 per square, f. o. b. quarry, depending on quality. The Ferry Building, San Francisco, is roofed with Eureka slate.

A complete record of amount and value of slate produced in California follows:

Year	Squares	Value	Year	Squares	Value
1889	4,500	$18,089	1905	4,000	$40,000
1890	4,000	24,000	1906	10,000	100,000
1891	4,000	24,000	1907	7,000	60,000
1892	3,500	21,000	1908	6,000	60,000
1893	3,000	21,000	1909	6,961	45,660
1894	1,800	11,700	1910	1,000	8,000
1895	1,350	9,450	1911	----------	----------
1896	500	2,500	1912	----------	----------
1897	400	2,800	1913	----------	----------
1898	400	2,800	1914	----------	----------
1899	810	5,900	1915	1,000	5,000
1900	3,500	26,250	1916	----------	----------
1901	5,100	38,250	1917	----------	----------
1902	4,000	30,000			
1903	10,000	70,000	Totals	88,821	$676,399
1904	6,000	50,000			

MISCELLANEOUS STONE.

Bibliography: State Mineralogist Reports XII, XIII, XIV. Bulletin 38.

Miscellaneous stone is the name used throughout this report as the title for that branch of the mineral industry covering crushed rock of all kinds, paving blocks, sand and gravel, and pebbles for grinding mills. The foregoing are very closely related from the standpoint of the producer. Thus it has been found to be most satisfactory to group these items as has been done in recent reports of this Bureau. In so far as it has been possible to do so, crushed rock production has been subdivided into the various uses to which the product was put. It will be noted, however, a very large percentage of the output has been tabulated under the heading 'Unclassified.' This is necessary because of the fact that many of the producers have no way of telling to what specific use their rock was put after they have quarried and sold the same.

In addition to amounts produced by commercial firms, both corporations and individuals, there is hardly a county in the state but uses more or less gravel and broken rock on its roads. Of much of this, particularly in the country districts, there is no definite record kept. Estimates have been made for some of this output, based on the mileage of roads repaired.

For the year 1917, miscellaneous stone shows a decrease from the preceding year of $536,752 in value. The total value for 1917 was $3,634,767, as compared with $4,171,519 for 1916; $4,783,180 for 1915, with $4,231,571 for 1914, and $5,186,743 for 1913.

As has been the case for several years past, Los Angeles County led all others by a wide margin, with an output valued at $608,026; followed by Alameda, second, with $413,845; Contra Costa, third, $322,507; and Sacramento, fourth, $199,839.

In California, the general construction situation in 1917 appeared about normal so far as small jobs were concerned; but there were few large pieces of work done except highway contracts.

Paving Blocks.

The paving block industry has decreased materially of recent years, because of the increased construction of smoother pavements demanded by motor vehicle traffic. The blocks made in Solano County were of basalt; those from Sonoma are of basalt, andesite and some trachyte; while those from all the other counties shown in the tabulation, are of granite.

Paving Block Production, by Counties, for 1917:

County	Amount, M	Value
Sonoma	863	$35,930
Riverside and San Diego*	65	2,637
Totals	928	$38,567

*Combined to conceal output of a single producer in each.

The amount and value of paving block production annually since 1887 has been as follows:

Year	Amount M.	Value	Year	Amount M.	Value
1887	*10,000	$350,000	1904	3,977	$161,752
1888	10,500	367,500	1905	3,408	134,347
1889	7,303	297,236	1906	4,203	173,432
1890	7,000	245,000	1907	4,604	199,347
1891	5,000	150,000	1908	7,660	334,780
1892	*3,000	96,000	1909	4,503	199,803
1893	2,770	96,950	1910	4,434	198,916
1894	2,517	66,981	1911	4,141	210,819
1895	2,332	73,338	1912	11,018	578,355
1896	4,161	77,584	1913	6,364	363,505
1897	1,711	35,235	1914	6,053	270,598
1898	1,144	21,725	1915	3,285	171,092
1899	305	7,861	1916	1,322	54,362
1900	1,192	23,775	1917	938	38,567
1901	1,920	41,075			
1902	3,502	112,437	Totals	135,111	$5,287,014
1903	4,854	134,642			

*Figures for 1887–1892 (inc.) are for Sonoma County only, as none are available for other counties during that period; though Solano County quarries were then also quite active.

Grinding Mill Pebbles.

In 1915, for the first time we were able to record a production of pebbles for tube and other grinding mills. Owing to the decreased imports and higher prices of Belgium and other European flint pebbles, there has been a serious inquiry for domestic sources of supply. One of the shipments made in that year was of pebbles selected from gold dredger tailings in Sacramento County, for use in a gold mill in Amador County employing Hardinge mills.

The important development in this item, however, has been in San Diego County. At several points along the ocean shore from Encinitas south to near San Diego, there are beaches of washed pebbles varying from 1 inch to 6 inches in diameter, which came from conglomerate beds made up of well-rounded water-worn pebbles of various granitic and porphyritic rocks with some felsite and flint. The wave action has broken down portions of the cliffs for considerable distances and formed beaches of the pebbles which are well washed and cleaned of the softer materials. The rocks sorted out for shipment are mainly basalt and diabase, with an occasional felsite and flint pebble. There is a tough, black basalt which is stated to be giving satisfactory results. The Fresno County pebbles are selected from the gravel beds of the San Joaquin River near Friant. Shipments are being made to metallurgical plants in California, Nevada, Montana and Utah.

Grinding Mill Pebbles Production, for 1917.

County	Tons	Value
Fresno and San Diego*	21,450	$90,538

*Combined to conceal output of a single producer in Fresno County.

The amount and value of grinding mill pebbles, annually, follows:

Year	Tons	Value
1915	340	$2,810
1916	20,232	107,567
1917	21,450	90,538
Totals	42,022	$200,915

Sand and Gravel Production, by Counties, for 1917.

County	Tons	Value
Alameda	†939,591	$277,642
Calaveras	5,500	2,000
Colusa	1,600	600
Contra Costa	32,008	9,429
Del Norte	1,600	700
El Dorado	5,200	3,200
Fresno	300,057	102,893
Glenn	296,611	33,260
Humboldt	10,301	9,810
Imperial	27,842	2,041
Inyo	3,500	3,000
Lake	5,000	2,000
Los Angeles	773,855	252,035
Marin	5,733	2,240
Mendocino	1,500	600
Monterey	‡106,964	57,810
Napa	219,982	89,293
Nevada	1,900	700
Orange	12,778	2,699
Riverside	4,000	1,500
Sacramento	140,137	30,753
San Benito	7,660	3,000
San Bernardino	118,488	20,163
San Diego	§52,940	22.335
San Joaquin	165,721	47,090
San Luis Obispo	12,407	7,147
Santa Clara	160,004	66,019
Siskiyou	27,255	6,947
Solano	1,000	400
Sonoma	55,114	21,605
Stanislaus	22,702	6,240
Tehama	3,200	1,200
Trinity	500	500
Tuolumne	1,600	700
Yuba	146,614	28,863
Butte, Madera, Merced, Placer, San Francisco, San Mateo, Tulare, Ventura, Yolo*	403,129	118,517
Totals	4,073,993	$1,234,931

*Combined to conceal output of a single operator in each.
†Includes moulding sand.
‡Includes moulding sand and roofing sand.
§Includes brass-foundry and moulding sand.

Crushed Rock Production, by Counties, for 1917.

County	Macadam and ballast		Rubble and riprap		Concrete		Unclassified		Totals	
	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value
Alameda	26,186	$10,832			99,784	$50,845	124,824	$74,526	250,794	$136,203
Amador	3,000	1,200							3,000	1,200
Calaveras	2,500	700							2,500	700
Contra Costa	31,439	14,956	43,445	$32,584	239,147	154,051	177,189	111,487	491,220	313,078
Del Norte	3,000	2,000							3,000	2,000
El Dorado	10,000	3,000							10,000	3,000
Humboldt	6,153	9,878	18,855	7,000	217	326			25,225	17,204
Kern					56,311	31,787			56,311	31,787
Lake	2,000	500							2,000	500
Lassen	889	376							889	376
Los Angeles	288,060	140,135	21,943	19,232	80,338	55,780	266,743	140,844	657,084	355,991
Madera					500	325			500	325
Marin	200	200	106,272	72,386	201,832	83,606	300	150	308,604	156,342
Mendocino	15,000	5,000							15,000	5,000
Modoc	500	200							500	200
Napa	25,643	19,232			1,667	1,250	352	264	27,662	20,746
Nevada	2,500	900							2,500	900
Placer			9,147	3,227					9,147	3,227
Plumas	6,415	1,322							6,415	1,322
Riverside	89,646	41,487	47,604	25,847	60	15	450	1,438	137,760	68,787
Sacramento			232	93			311,988	168,993	312,220	169,086
San Bernardino			322,310	87,540			13,819	3,455	336,129	90,995
San Diego			1,510	1,087			15,120	12,335	16,630	13,422
San Francisco	66,827	53,720			41,818	24,180	42,749	27,057	151,394	104,957
San Luis Obispo	2,400	1,200					100	75	2,500	1,275
San Mateo	42,190	39,867	2,500	2,000	22,501	20,408			67,191	62,275
Santa Barbara	2,000	3,750	50	200			5,333	2,000	7,383	5,950
Santa Clara							52,857	45,285	52,857	45,285
Santa Cruz					2,368	2,368			2,368	2,368
Shasta	2,500	800							2,500	800
Siskiyou	6,102	4,435			54,667	123,000			60,769	127,435

Sonoma	18,137	11,212	59	30	1,186	964	133,293	76,880	152,675	89,086
Sutter							4,500	5,000	4,500	5,000
Tehama	1,564	1,173							1,564	1,173
Trinity	24,060	7,218							24,060	7,218
Tuolumne	2,500	1,000					300	2,100	2,800	3,100
Yolo	1,000	300							1,000	300
Butte, Fresno, Imperial, Mariposa, Merced, San Benito, San Joaquin, Solano, Tulare*	233,357	88,339	85,001	63,689	174,297	84,048	293,972	186,042	786,627	422,118
Totals	915,768	$464,932	658,928	$314,915	976,693	$632,953	1,443,889	$857,931	3,995,278	$2,270,731

*Combined to conceal output of a single operator in each.

A comparison of the table of annual productions of these materials with the similar table for cement (see *ante*), reveals the fact that the important growth of the crushed rock and gravel business was coincident with the rapid development of the cement industry from the year 1902.

The amount and value, annually, of crushed rock (including macadam, ballast, rubble, riprap, and that for concrete), and sand and gravel, since 1893, follow:

Crushed Rock, Sand and Gravel, by Years.

Year	Tons	Value	Year	Tons	Value
1893	371,100	$456,075	1907	2,288,888	$1,915,015
1894	661,900	664,838	1908	3,998,945	3,241,774
1895	1,254,688	1,095,939	1909	5,531,561	2,708,326
1896	960,619	839,884	1910	5,827,828	2,777,690
1897	821,123	600,112	1911	6,487,223	3,610,357
1898	1,177,365	814,477	1912	8,044,937	4,532,598
1899	964,898	786,892	1913	9,817,616	4,823,056
1900	789,287	561,642	1914	9,288,397	3,960,973
1901	530,396	641,037	1915	10,879,497	4,609,278
1902	2,056,015	1,249,529	1916	9,951,089	4,009,590
1903	2,215,625	1,673,591	1917	8,069,271	3,505,662
1904	2,296,898	1,641,877			
1905	2,624,257	1,716,770	Totals	98,464,795	$53,855,388
1906	1,555,372	1,418,406			

Total Value of Production of 'Miscellaneous Stone' (Crushed Rock, Sand, Gravel, Paving Blocks and Grinding Mill Pebbles), by Counties, for 1917.

County	Value	County	Value
Alameda	$413,845	Plumas	$1,322
Amador	1,200	Riverside	72,364
Butte	89,870	Sacramento	199,839
Calaveras	2,700	San Benito	101,148
Colusa	600	San Bernardino	111,158
Contra Costa	322,507	San Diego	125,855
Del Norte	2,700	San Francisco	107,957
El Dorado	6,200	San Joaquin	55,003
Fresno	136,719	San Luis Obispo	8,422
Glenn	33,260	San Mateo	71,668
Humboldt	27,014	Santa Barbara	5,950
Imperial	65,660	Santa Clara	111,304
Inyo	3,000	Santa Cruz	2,368
Kern	31,787	Shasta	800
Lake	2,500	Siskiyou	134,382
Lassen	376	Solano	39,826
Los Angeles	608,026	Sonoma	146,621
Madera	1,525	Stanislaus	6,240
Marin	158,582	Sutter	5,000
Mariposa	7,646	Tehama	2,373
Mendocino	5,600	Trinity	7,718
Merced	70,500	Tulare	75,594
Modoc	200	Tuolumne	3,800
Monterey	57,810	Ventura	30,000
Napa	110,039	Yolo	4,300
Nevada	1,600	Yuba	28,863
Orange	2,699		
Placer	10,727	Total	$3,634,767

CHAPTER FIVE.

INDUSTRIAL MATERIALS.

Bibliography: Reports XIV, XV; Bulletin 38. Min. & Sci. Press, Vol. 114, Mar. 10, 1917.

The following mineral substances have been arbitrarily arranged under the general heading of Industrial Materials, as distinguished from those which have a clearly defined classification, such as metals, salines, structural materials, etc.

These materials, many of which are mineral earths, are as yet produced on a comparatively small scale. With but few exceptions the possibilities of development along these lines are large and with increasing transportation, and other facilities, together with steadily growing demands, the future for this branch of the mineral industry in California is certainly promising. There is scarcely a county in the state but might contribute to the output.

Up to within the last two or three years, at least, production has been in the majority of instances dependent upon more or less of a strictly local market, and the annual tables show the results of such a condition, not only in the widely varying amounts of a certain material produced from year to year, but in widely varying prices of the same material, often in different sections of the state. Furthermore, the quality of this general class of material will be found to fluctuate, even in the same deposit, especially as regards price. The war in Europe has affected some of these items, but not to the striking degree that it has the metal markets.

The following summary shows the value of the industrial materials produced in California during the years 1916–1917, with increase or decrease in each instance:

	1916		1917		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Asbestos	145 tons	$2,380	136 tons	$10,225	$7,845+
Barytes	1,603 tons	5,516	4,420 tons	25,633	20,117+
Clay (pottery)	134,636 tons	146,538	165,298 tons	154,602	8,064+
Dolomite	13,313 tons	46,563	27,911 tons	66,416	19,850+
Feldspar	2,630 tons	14,350	11,792 tons	46,411	32,061+
Fluorspar			*	*	* +
Fullers earth	110 tons	550	2.0 tons	2,180	1,630+
Gems		4,752		3,049	1,703—
Graphite	29,190 lbs.	2,335	*	*	* +
Gypsum	35,384 tons	59,533	30,825 tons	56,840	2,693—
Infusorial and diatomaceous earths	15,322 tons	80,649	24,301 tons	127,510	46,861+
Limestone	187,521 tons	217,733	237,279 tons	355,396	138,663+
Lithia	71 tons	1,065	880 tons	8,800	7,735+
Mineral paint	613 tons	3,960	520 tons	2,700	1,260—
Mineral water	2,273,817 gals.	410,112	1,942,620 gals.	340,666	69,446—
Pumice and volcanic ash	1,246 tons	18,092	525 tons	5,295	12,797—
Pyrite	120,525 tons	372,969	111,325 tons	523,704	49,265—
Silica (sand and quartz)	20,880 tons	48,908	19,376 tons	41,166	7,742—
Soapstone and talc	1,703 tons	9,831	5,267 tons	45,279	35,448+
Strontium	57 tons	2,850	3,050 tons	37,000	34,150+
Fluorspar and graphite*				5,612	3,277+
Totals		$1,448,689		$1,659,484	
Net increase					$210,795+

*Combined to conceal output of a single operator in each.

ASBESTOS.

Bibliography: State Mineralogist Reports XII, XIII, XIV. Bulletin 38. Canadian Dept. of M., Mines Branch, Bull. 69.

Though asbestos of various grades is known to exist widely distributed in California, the production for the year 1917 was but 136 tons valued at $10,225. This was principally from Inyo and Nevada counties, with smaller amounts from Fresno and Placer counties.

The increased value of the smaller tonnage of 1917 compared with the 1916 output is due to the Nevada County material which yields a good proportion of medium-length chrysotile with some high-grade spinning fibre. The Washington Asbestos Company has opened up a promising deposit there, and is milling its rock in an old 20-stamp gold-mill converted to their purposes, to which fiberizing machinery has been added. They report prospects for an increased output in 1918.

The bulk of the world's supply of this mineral comes from Canada; and Canadian asbestos, so far, leads in quality as well as in quantity.

Classification and Characteristics.

The word asbestos (derived from the Greek, meaning incombustible) as used here includes several minerals, from a strictly mineralogical standpoint. There are two main divisions, however; amphibole and chrysotile. The fibrous varieties of several of the amphiboles (silicates chiefly of lime, magnesia and iron), notably tremolite and actinolite, are called asbestos. Their fibres usually lie parallel to the fissures containing them. Amphibole asbestos possesses high refractory properties, but lacks strength of fibre, and is applicable principally for covering steam pipes and boilers. Chrysotile, a hydrous silicate of magnesia, is a fibrous form of serpentine, and often of silky fineness. Its fibres are formed at right angles to the direction of the fissures containing them. Chrysotile fibres, though short, have considerable strength and elasticity, and may be spun into threads and woven into cloth. To bring the highest market price asbestos must needs have a combination of properties, *i. e.*, length and fineness of fibre, tensile strength and flexibility—all combined with infusibility. Of these qualities the most important are toughness and infusibility, and determination of the same can only be made by practical tests or in the laboratory.

Asbestos, roughly speaking, was worth from $20 to $200 per ton, before the war. Under the stimulus of war conditions, the demand has caused a material increase in prices. The poorer grades which are unsuitable for weaving, and which, of course, command the lower prices, are used in the manufacture of steam packing, furnace linings, asbestos brick, wall plasters, paints, tiling, asbestos board, shingles, insulating material, etc. The better grades are utilized in the manufacture of tapestries of various kinds, fireproof theater curtains, cloth, rope, etc.

A very important development of the asbestos industry is the rapidly increasing demand for the lower grade material, on account of the numerous diversified uses to which asbestos products are being put, in almost every branch of manufacture. This fact means that many deposits of asbestos will become commercially important even though the grade of the material is far from the best.

It has been discovered only recently that not only does an asbestos wall plaster render the wall so covered impervious to heat, but that in rooms which have given forth an undesirable echo this evil has been absolutely removed. Asbestos pulp mixed with cement and magnesite has been experimented with; and roofing, flooring, and other building material of the most satisfactory sort has been manufactured therefrom.

Value and Production.

Total amount and value of asbestos production in California since 1887, as given in the records of this Bureau, are as follows:

Year	Tons	Value	Year	Tons	Value
1887	30	$1,800	1904	10	$162
1888	30	1,800	1905	112	2,625
1889	30	1,800	1906	70	3,500
1890	71	4,260	1907	70	3,500
1891	66	3,960	1908	70	6,100
1892	30	1,830	1909	65	6,500
1893	50	2,500	1910	200	20,000
1894	50	2,250	1911	125	500
1895	25	1,000	1912	90	2,700
1896	------	------	1913	47	1,175
1897	------	------	1914	51	1,530
1898	10	200	1915	143	2,860
1899	30	750	1916	145	2,380
1900	50	1,250	1917	136	10,225
1901	110	4,400			
1902	------	------	Totals	1,916	$91,557
1903	------	------			

BARYTES.

Bibliography: State Mineralogist Reports XII, XIV, XV. Bulletin 38.

The output of crude barytes during 1917 was 4,420 tons, valued at $25,633, from Mariposa, Monterey and Inyo counties, as compared with the 1916 production of 1,606 tons, worth $5,516. This mineral is ordinarily sorted and ground before being put on the market, and in this prepared condition brings from $15 to $25 per ton. The values reported for the crude material in 1917 varied from $6 to $10 per ton f. o. b. rail. The principal use of barytes is in the paint industry; also in certain rubber articles. Minor uses are in tanning of leather, manufacture of paper and rope, and sugar refining. A grinding and chemical plant is in operation at Melrose, Alameda County, making a specialty of barium compounds; and another at South San Francisco.

Known occurrences of this mineral in California are located in Inyo, Los Angeles, Mariposa, Monterey, San Bernardino, and Santa Barbara counties. The deposit at El Portal, in Mariposa County, has given the largest commercial production to date. The tonnage above recorded is in part, witherite (barium carbonate, $BaCO_3$) from El Portal. The 1915 output was the first commercial production of the carbonate in the United States, of which we have record. The El Portal witherite and barite are both high grade. In 1916, output began from a new deposit opened up on Fremont's Peak, Monterey County, near the line of San Benito County.

The first recorded production of barytes in California, according to the statistical reports of the State Mining Bureau, was in 1910. The annual figures are as follows:

Year	Tons	Value	Year	Tons	Value
1910	860	$5,640	1915	410	$620
1911	309	2,207	1916	1,606	5,516
1912	564	2,812	1917	4,420	25,633
1913	1,600	3,680			
1914	2,000	3,000	Totals	11,769	$49,108

CLAY—POTTERY.

Bibliography: State Mineralogist Reports I, IV, IX, XII, XIII, XIV, XV. Bulletin 38.

At one time or another in the history of the state, pottery clay has been quarried in thirty-three of its counties. In this report pottery clay refers to all clays used in the manufacture of red and brown earthenware, flower pots, ornamental tiling, architectural terra cotta, sewer pipe, etc., and the figures for amount and value are relative to the crude material at the pit, without reference to whether the clay was sold in the crude form, or whether it was immediately used in the manufacture of any of the above finished products by the producer. It does not include clay used in making brick and building blocks.

During 1917 producers in 13 counties reported an output of 166,298 tons of clay, having a spot value of $154,602 for the crude material, at the pits, as compared with the 1916 production of 134,636 tons worth $146,538.

A tabulation of the direct returns from the producers, by counties, for the year 1917, is shown herewith:

County	Tons	Value	Used in manufacture of—
Alameda	6,502	$4,524	Architectural terra cotta, sewer pipe, and drain tile.
Amador	†28,970	28,625	Fire-clay products, sewer and chimney pipe, architectural terra cotta, porcelain, stoneware, pottery, sanitary ware, and drain tile.
Los Angeles	6,276	10,321	Terra cotta, sewer pipe, chimney pipe, roofing tile, and drain tile.
Placer	44,097	44,097	Terra cotta, roofing et al. tile, sewer and chimney pipe, architectural terra cotta, sanitary ware.
Riverside	70,798	55,491	Sewer pipe, pottery, terra cotta, et al.
Sacramento	310	410	Drain tile, flower pots, and stoneware.
Santa Clara	6,014	4,929	Red earthenware, stoneware, drain tile, sewer pipe, terra cotta, et al.
Calaveras,‡ Humboldt, Kern, Napa, Orange, San Bernardino, San Diego*	3,331	6,205	Chimney and vitrified sewer pipe, stoneware, porcelain, drain, roof, floor and faience tile.
Totals	166,298	$154,602	

*Combined to conceal output of a single operator in each.
†Includes washed kaolin; also some 'fire sand' used in making fire-brick.
‡Clay for use on metallurgical furnaces.

Because of the fact that a given product often requires a mixture of several different clays, and that these are not all found in the same pit, it is necessary for most clay-working plants to buy some part of their raw materials from other localities. For these reasons, in compiling the clay industry figures, much care is required to avoid duplications. The new form of clay blank sent out by the State Mining Bureau, the past two years, and the coöperation of the operatives in filling it out, has enabled us to make a more intelligent compilation of the data than previously, both as to sources of the crude material and as to kinds and values of the manufactured articles. So far as we have been able to segregate them, we have credited the clay output to the counties from which the raw material originated.

The values of the various pottery clay products made in California during 1917, totaled $2,106,460, compared with $1,844,474 in 1916, their distribution being shown in the following tabulation:

Values of Pottery Clay Products, 1917.

Product	Number of producers	Value
Architectural terra cotta	7	$536,718
Chimney pipe and flue linings	5	38,627
Drain tile	9	48,366
Roofing tile	5	125,637
Sewer pipe	9	699,378
Stoneware and sanitary ware	5	463,736
Red earthenware	2	22,650
Miscellaneous—including art pottery, conduit pipe, floor and faience tile	9	171,348
Total		$2,106,460

Amount and value of crude pottery clay output in California since 1887 are given in the following table:

Year	Tons	Value	Year	Tons	Value
1887	75,000	$37,500	1904	84,149	$81,952
1888	75,000	37,500	1905	133,805	130,146
1889	75,000	37,500	1906	167,267	162,283
1890	100,000	50,000	1907	160,385	254,454
1891	100,000	50,000	1908	208,042	325,147
1892	100,000	50,000	1909	299,424	465,647
1893	24,856	67,284	1910	249,028	324,099
1894	28,475	35,073	1911	224,576	252,759
1895	37,660	39,685	1912	199,605	215,683
1896	41,907	62,900	1913	231,179	261,273
1897	24,592	30,290	1914	179,948	167,552
1898	28,947	33,747	1915	157,866	133,724
1899	40,600	42,700	1916	134,636	146,538
1900	59,636	60,956	1917	166,298	154,602
1901	55,679	39,144			
1902	67,933	74,163	Totals	3,622,465	$3,924,208
1903	90,972	99,907			

DOLOMITE.

Bibliography: Bulletin 67. Report XV.

In the 1915 report, dolomite was for the first time made the subject of a separate classification. Previously it had been included under limestone. Limestones are frequently more or less magnesian-bearing, and a chemical analysis is often necessary to definitely decide as to whether they are calcite or dolomite; the latter standing intermediate between magnesite ($MgCO_3$) and calcite ($CaCO_3$). Since dolomite, as such, has been found to have certain distinctive applications, we have deemed it worthy of a separate classification.

The major portion of the tonnage being shipped is utilized as a refractory lining in the bottoms of open-hearth steel furnaces, as a partial substitute for magnesite. A portion is used for its carbonic acid gas (CO_2), and part for its magnesia. We are also informed that some calcined dolomite was used in 1917 by the paper mills. As the San Benito and Monterey dolomite has been found to contain the proper proportions of lime and magnesia, it can replace an artificial mixture of calcined limestone and magnesite in the manufacture of paper from wood pulp. Dolomite is also sometimes used as a flux in metal smelting.

The production of dolomite for the year 1917 amounted to 27,911 tons, valued at $66,416 and came from a total of 9 quarries in 5 counties distributed as follows:

County	Tons	Value
Inyo	11,315	$22,630
Monterey	6,392	23,468
San Benito	7,000	15,000
San Bernardino and Tuolumne*	3,204	5,318
Totals	27,911	$66,416

*Combined to conceal output of a single operator in each.

Amount and value of the output of dolomite, annually, have been as follows:

Year	Tons	Value
1915	4,192	$14,504
1916	13,313	46,566
1917	27,911	66,416
Totals	45,416	$127,486

FELDSPAR.

Bibliography: Report XV. Bulletin 67. U. S. Bur. of M., Bull. 92.

Feldspar was produced in four counties during 1917, to the amount of 11,792 tons, valued at $46,411. The considerable increase over the 1916 figures is due to the output of Riverside County, which was used in cement manufacture, so that its potash content could be recovered as a by-product. Other cement companies in the state are considering a similar course of action.

Feldspar production only dates back to 1910 in California. The mineral is a constituent of many rocks, but can only be commercially produced from pegmatites where the crystals are large and quite free from impurities. The open-cut method of mining this material is commonly used. Manufacturers of enamel wares and pottery have previously bought most of the better grades of feldspar produced. Small quantities are used in the manufacture of glass and scouring soaps, and the more impure material is utilized as chicken grit, in making various brands of roofing, and in other ways. Various experiments have been made with the potash feldspars in the attempt to extract their potash content for use in fertilizers. Some recent successes along these lines are enumerated under Potash.

The 1917 output in California was distributed by counties, as follows:

County	Tons	Value
Riverside	11,097	$42,900
Tulare	240	1,580
Kern and San Bernardino*	455	1,931
Totals	11,792	$46,411

*Combined to conceal output of a single operator in each.

Total amount and value of feldspar production in California since the inception of the industry are given in the following table, by years:

Year	Tons	Value	Year	Tons	Value
1910	760	$5,720	1915	1,800	$9,000
1911	740	4,560	1916	2,630	14,350
1912	1,382	6,180	1917	11,792	46,411
1913	2,129	7,850			
1914	3,530	16,565	Totals	24,763	$110,631

FLUORSPAR.

Bibliography: Bulletin 67.

Fluorspar is used as a flux in steel and iron smelting, and in the production of aluminum. It is also utilized in the manufacture of hydrofluoric acid, glass, porcelain, enamels and sanitary ware.

In California, deposits have been reported in Los Angeles, Mono, Riverside, and San Bernardino counties, but up to 1917 no commercial production had resulted. As this initial output came from a single operator in Riverside County, the amount and value are concealed under the Unapportioned item.

FULLER'S EARTH.

Bibliography: Bulletin 38. U. S. Bur. of M., Bull. 71.

Fuller's earth production in California during the year 1917 amounted to 220 tons, valued at $2,180, as compared with 110 tons valued at $550 in 1916.

This material is soft and friable, and, in general, resembles a clay, but is non-plastic. It has no definite mineralogical composition, and its commercial value is determined by its physical properties, *i. e.*, texture, and filtering and absorbent properties.

In California, fuller's earth is used in clarifying both refined mineral and vegetable oils, although its original use was in fulling wool, as the name indicates. During 1917 the production came from Calaveras and Solano counties. A large deposit of high-grade fuller's earth has been found near Elsinore in Riverside County. Some has come from Fresno and Kern counties.

It was first produced commercially in this state in 1899, and the total amount and value of the output since that time are as follows:

Year	Tons	Value	Year	Tons	Value
1899	620	$12,400	1910	340	$3,820
1900	500	3,750	1911	466	5,294
1901	1,000	19,500	1912	876	6,500
1902	987	19,246	1913	460	3,700
1903	250	4,750	1914	760	5,928
1904	500	9,500	1915	692	4,002
1905	1,344	38,000	1916	110	550
1906	440	10,500	1917	220	2,180
1907	100	1,000			
1908	50	1,000	Totals	10,174	$159,005
1909	459	7,385			

GEMS.

Bibliography: State Mineralogist Reports II, XIV. Bulletins 37, 67.

Accounting for the production of gems in California is somewhat unsatisfactory, owing to the widely scattered places at which stones are gathered and marketed in a very small way. The following table shows the production, by counties, of rough uncut materials during 1917:

County	Value	Kind
Butte	$125	Diamonds.
Los Angeles	300	Beach pebbles.
San Mateo	150	Beach pebbles.
Placer, Plumas, Riverside, San Bernardino, San Diego*	2,474	Garnet, opal, californite, quartz crystals, chalcedony, kunzite, and tourmaline.
Total value	$3,049	

*Combined to conceal output of a single operator in each.

California tourmalines are decidedly distinctive in coloring and 'fire' as compared to foreign stones of this classification. The colors range from deep ruby to pink, and various shades of green; also more recently a blue tourmaline has been found.

Two of our California gem stones, kunzite and benitoite, are not found elsewhere in the world; and these, each in but a single locality here: the former in the Pala Chief Mine in San Diego County, and the latter in the Dallas Mine in San Benito County.

Some rhodonite has been mined in Siskiyou County, and used for decorative purposes, its value being included in the marble figures.

Diamonds have been found in a number of localities in California; but in every case, they have been obtained in stream gravels while working them for gold. The principal districts have been: Volcano in Amador County; Placerville, Smith's Flat and others in El Dorado County; French Corral, Nevada County; Cherokee Flat and Yankee Hill, Butte County; Gopher Hill and upper Spanish Creek, Plumas County. The most productive district of recent years has been Cherokee in Butte County.

There was some chrysoprase mined in 1917, in Tulare County, but not sold, until later.

The value of the total gem production in California annually since the beginning of commercial production is as follows:

Year	Value	Year	Value
1900	$20,500	1910	$237,475
1901	40,000	1911	51,824
1902	162,100	1912	23,050
1903	110,500	1913	13,740
1904	136,000	1914	3,970
1905	148,500	1915	3,565
1906	497,090	1916	4,752
1907	232,642	1917	3,049
1908	208,950		
1909	193,700	Total	$2,091,407

GRAPHITE.

Bibliography: State Mineralogist Reports XIII, XIV, XV. Bulletin 67. U. S. G. S., Min. Res. 1914, Pt. II.

Graphite has been produced from time to time in the state, coming principally from Sonoma and Los Angeles counties. It is difficult for these deposits, which are not high grade, to compete with foreign supplies which go on the market almost directly as they come from the deposit. Low-grade ores are concentrated with considerable difficulty and the electric process of manufacturing artificial graphite from coal has been perfected to such a degree that only deposits of natural graphite of a superior quality can be exploited with any certainty of success.

According to a recent report by the U. S. Geological Survey, "at present prices, miners in this country who are working disseminated flake deposits must depend on their No. 1 and 2 flake for their profit. Graphite dust is merely a by-product and is salable only at a low price. Improved methods of graphite milling, adopted during the last year, promise to increase largely the production of flake of better grade."

On account of its infusibility and resistance to the action of molten metals, graphite is very valuable. It is also largely used in the manufacture of electrical appliances, of 'lead' pencils, as a lubricant, as stove polish, and in many other ways. Amorphous graphite, commonly carrying many impurities, brings a much lower price. For some purposes, such as foundry facings, etc., the low-grade material is satisfactory. The price increases with the grade of the material until the best quality crystalline variety, ranges as high as $200 per ton. Because of the present increased demand for brass and crucible steel, the requirement for graphite crucibles has gone up rapidly, thus boosting the price of flake graphite to above $400 per ton for Ceylon lumps. The coarser flakes are necessary for crucibles as they help to bind the clay together in addition to their refractory service.

Among the newer uses for graphite is the prevention of formation of scale in boilers. The action is a mechanical one. Being soft and slippery, the graphite prevents the particles of scale from adhering to one another or to the boiler and they are thus easily removed.

Occurrence of graphite has been reported at various times from Calaveras, Fresno, Imperial, Los Angeles, Mendocino, San Bernardino, San Diego, Siskiyou, Sonoma and Tuolumne counties.

During 1917 production was reported from Los Angeles County. It was concentrated from a disseminated ore, and was used for paint, foundry facing, and lubricants. As there was but a single operator, the figures are concealed under the 'Unapportioned' item. The production, by years, has been as follows:

Year	Pounds	Value
1901	128,000	$4,480
1902	84,000	1,680
1903	----------	----------
1913	2,500	25
1914	----------	----------
1915	----------	----------
1916	29,190	2,335
1917	*	*
Totals	243,690	$8,520

*Concealed under 'Unapportioned,' on account of a single producer.

GYPSUM.

Bibliography: Bulletins 38, 67. Reports XIV, XV.

Gypsum is widely distributed throughout the state, and is produced to a considerable extent, to supply the fertilizer manufacturers and those of plaster and cement.

During 1917, seven producers in Inyo, Riverside and San Bernardino counties took out a total of 30,825 tons, valued at $56,840. This is a slight decrease from the 33,384 tons, valued at $59,533 in 1916. The 1917 output was distributed by counties, as follows:

County	Tons	Value
Riverside	1,923	$3,001
Inyo and San Bernardino*	28,902	53,839
Totals	30,825	$56,840

*Combined to conceal output of a single operator in each.

Total annual production of gypsum in California since such records have been compiled by this Bureau is as follows:

Year	Tons	Value	Year	Tons	Value
1887	2,700	$27,000	1904	8,350	$56,592
1888	2,500	25,000	1905	12,850	54,500
1889	3,000	30,000	1906	21,000	69,000
1890	3,000	30,000	1907	8,900	57,700
1891	2,000	20,000	1908	34,600	155,400
1892	2,000	20,000	1909	30,700	138,176
1893	1,620	14,280	1910	45,294	129,152
1894	2,446	24,584	1911	31,457	101,475
1895	5,158	51,014	1912	37,529	117,388
1896	1,310	12,580	1913	47,100	135,050
1897	2,200	19,250	1914	29,734	78,375
1898	3,100	23,600	1915	20,200	48,953
1899	3,663	14,950	1916	33,384	59,533
1900	2,522	10,088	1917	30,825	56,840
1901	3,875	38,750			
1902	10,200	53,500	Totals	450,131	$1,719,171
1903	6,914	46,441			

INFUSORIAL and DIATOMACEOUS EARTHS.

Bibliography: State Mineralogist Reports II, XII, XIII, XIV. Bulletins 38, 67.

Infusorial and diatomaceous earths—sometimes called tripolite—are very light and extremely porous, chalk-like materials composed of pure silica (chalk, being calcareous) which has been laid down under water and consist of the remains of microscopical infusoria and diatoms. The former are animal remains, and the latter are from plants. Their principal commercial use is as an absorbent; and it is also employed in the manufacture of scouring soap and polishing powders, and in making some classes of refractory brick. It is a first-class nonconductor of heat, where high temperatures are employed, such as around steel and gas plants and power houses. In such cases, it is built in as an insulating layer in furnace walls. In Germany, under the name 'kieselguhr,' it was used as an absorbent for nitroglycerine in the early manufacture of dynamite.

The most important depósits in California thus far known are located in Monterey, Orange, San Luis Obispo, and Santa Barbara counties. The Santa Barbara material is diatomaceous and is of a superior quality. Infusorial earth is also found in Fresno, Kern, Los Angeles, Plumas, San Benito, San Bernardino, San Joaquin, Shasta, Sonoma, and Tehama counties.

During 1917, three quarries operating in Monterey and Santa Barbara counties, produced a total of 24,301 tons, valued at $127,510,

which is a material increase over the 15,322 tons, valued at $80,649, in 1916.

It will be noted that the average price varies widely from year to year. This fact is true in case of many of the industrial materials. The quality of the product fluctuates as does the demand; when both are favorable the maximum price obtains.

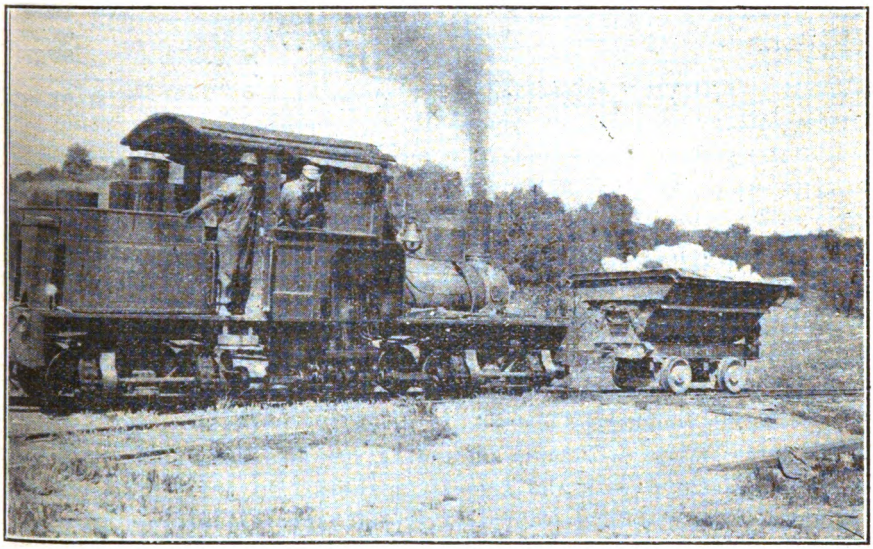
The first recorded production of these materials in California occurred in 1889; total amount and value of output, to date, are as follows:

Year	Tons	Value	Year	Tons	Value
1889	39	$1,335	1905	3,000	$15,000
1890			1906	2,430	14,400
1891			1907	2,531	28,948
1892			1908	2,950	32,012
1893	50	2,000	1909	500	3,500
1894	51	2,040	1910	1,843	17,617
1895			1911	2,194	19,670
1896			1912	4,129	17,074
1897	5	200	1913	8,645	35,968
1898			1914	12,840	80,350
1899			1915	12,400	62,000
1900			1916	15,322	80,649
1901			1917	24,301	127,510
1902	422	2,532			
1903	2,703	16,015	Totals	103,305	$671,102
1904	6,950	112,282			

LIMESTONE.

Bibliography: State Mineralogist Reports IV, XII, XIII, XIV, XV. Bulletin 38.

Limestone was produced in 12 counties during 1917, to the amount of 237,279 tons, valued at $356,396. This amount does not include the limestone used in the manufacture of cement nor of lime for building purposes, but accounts for that utilized as a smelter flux, for sugar making, and in other chemical and manufacturing processes (including fertilizers, roofing preparations, whiting for paint, terrazzo and for CO_2). The marked drop in the 1915 output as compared with the 1914 figures, was due in part to our transferring to the macadam classification a large tonnage of limestone employed as road metal, but which in preceding reports was classified as 'industrial' limestone.



Hauling limestone, near Shingle Springs, El Dorado County.

Distribution of the 1917 output is as follows:

County	Tons	Value
El Dorado	43,000	$93,500
San Bernardino	111,516	146,102
Santa Cruz	6,527	11,378
Shasta	57,128	69,993
Tuolumne	3,287	6,481
Alameda, Kern, Monterey, Santa Barbara, Santa Clara, Tulare*	15,821	28,942
Totals	237,279	$356,396

*Combined to conceal output of a single operator in each.

In the early reports of this Bureau values for lime and limestone were not segregated. The following tabulation shows the total combined value of such material since records for the state were first compiled, in 1887, to date:

Year	Value	Year	Value
1887	$368,750	1904	$658,956
1888	381,750	1905	878,647
1889	416,780	1906	925,887
1890	350,000	1907	1,162,417
1891	300.000	1908	676,507
1892	300,000	1909	997,745
1893	301,276	1910	1,058,891
1894	337,975	1911	843,778
1895	457,784	1912	1,034,688
1896	332,617	1913	803,002
1897	291,465	1914	896,376
1898	278,558	1915	442,592
1899	343,760	1916	608.208
1900	315,231	1917	667,776
1901	434,133		
1902	460.140	Total	$17,907,957
1903	582,268		

LITHIA.

Bibliography: State Mineralogist Reports II, IV, XIV. Bulletins 38, 67.

Lithia mica, lepidolite (a silicate of lithium *et al.*) utilized in the manufacture of artificial mineral water, fireworks, etc., was mined and sold in San Diego County during the years 1899–1905 inclusive, but there was no commercial production from the latter date, until 1915. Some amblygonite, a lithium phosphate, has also been obtained from pockets associated with the gem tourmalines. In 1917, the yield of lepidolite was 880 tons, valued at $8,800, and was utilized in glass manufacture.

Lithia mica total production in the state has been as follows:

Year	Tons	Value	Year	Tons	Value
1899	124	$4,600	1906		
1900	440	11,000	1915	91	$1,365
1901	1,100	27,500	1916	71	1,065
1902	822	31,880	1917	880	8,800
1903	700	27,300			
1904	641	25,000	Totals	4,894	$138,786
1905	25	276			

MICA.

Bibliography: State Mineralogist Reports II, IV. Bulletins 38, 67.

No commercial production of mica has recently been reported. Production in previous years has been as follows:

Year	Tons	Value
1902	50	$2,500
1903	50	3,800
1904	50	3,000
Totals	150	$9,300

MINERAL PAINT.

Bibliography: State Mineralogist Reports XII, XIII, XIV, XV. Bulletin 38.

Mineral paint was produced in California in 1917 from Calaveras, Colusa, San Bernardino and Stanislaus counties, amounting to 520 tons, valued at $2,700. This is a decrease from the tonnage and value of 1916. The material from Colusa and San Bernardino was hematite and jasper, while that from Calaveras and Stanislaus was yellow ochre. The latter is the equal of any of the imported ochres.

Besides the above-named counties, deposits of mineral paint are located in the following: Kern, Kings, Lake, Los Angeles, Nevada, Riverside, and Sonoma.

The first recorded production of this material in the state was in the year 1890. The output showing annual amount and value, since that time, is given herewith:

Year	Tons	Value	Year	Tons	Value
1890	40	$480	1905	754	$4,025
1891	22	880	1906	250	1,720
1892	25	750	1907	250	1,720
1893	590	26,795	1908	335	2,250
1894	610	14,140	1909	305	2,325
1895	750	8,425	1910	200	2,040
1896	395	5,540	1911	186	1,184
1897	578	8,165	1912	300	1,800
1898	653	9,698	1913	303	1,780
1899	1,704	20,294	1914	132	847
1900	529	3,993	1915	311	1,756
1901	325	875	1916	643	3,960
1902	589	1,533	1917	520	2,700
1903	2,370	3,720			
1904	270	1,985	Totals	13,939	$135,380

MINERAL WATER.

Bibliography: State Mineralogist Reports VI, XII, XIII, XIV, XV. U. S. G. S., Water Supply Paper 338.

A widespread production of mineral water is shown annually in California. These figures refer to mineral water actually bottled for sale, or for local consumption. Water from some of the springs having a special medicinal value brings a price many times higher than the average shown, while in some cases the water is used merely for drinking purposes and sells for a nominal figure. Health and pleasure resorts are located at many of the springs. The waters of some of the hot springs are not suitable for drinking, but are very efficacious for bathing. From a therapeutic standpoint, California is particularly rich in mineral springs. The counterparts of practically any of the world-famed spas of Europe or the eastern United States can be found here.

Commercial production by counties, for 1917 was:

County	Gallons	Value
Butte	3,500	$1,450
Calaveras	16,985	7,009
Contra Costa	436,265	8,563
Lake	129,157	22,685
Los Angeles	188,368	16,902
Napa	126,124	70,058
San Bernardino	11,300	1,620
San Luis Obispo	1,500	300
Santa Barbara	104,991	86,026
Santa Clara	10,230	1,923
Siskiyou	503,000	50,600
Solano	10,960	2,580
Sonoma	121,290	35,031
Colusa, Fresno, Humboldt, Marin, Monterey, Riverside, San Benito, San Diego, Shasta, Trinity*	278,350	35,919
Totals	1,942,020	$340,666

*Combined to conceal output of a single operator in each.

Amount and value of mineral water produced in California since 1887 are given herewith:

Year	Gallons	Value	Year	Gallons	Value
1887	618,162	$144,368	1904	2,430,320	$496,946
1888	1,112,202	252,990	1905	2,194,150	538,700
1889	808,625	252,241	1906	1,585,690	478,186
1890	258,722	89,786	1907	2,924,269	544,016
1891	334,553	139,959	1908	2,789,715	560,507
1892	331,875	162,019	1909	2,449,834	465,488
1893	383,179	90,667	1910	2,335,259	522,009
1894	402,275	184,481	1911	2,637,669	590,654
1895	701,397	291,500	1912	2,497,794	529,384
1896	808,843	337,434	1913	2,350,792	599,748
1897	1,508,192	345,863	1914	2,443,572	476,169
1898	1,429,809	213,817	1915	2,274,267	467,738
1899	1,338,537	406,691	1916	2,273,817	410,112
1900	2,456,115	268,607	1917	1,942,020	340,566
1901	1,555,328	559,057			
1902	1,701,142	612,477	Totals	50,934,464	$11,930,381
1903	2,056,340	558,201			

PHOSPHATES.

Bibliography: Bulletin 67.

No commercial production of phosphates has been recorded from California, though occasional pockets of the lithia phosphate, amblygonite, Li (AlF) PO_4, have been found associated with the gem tourmaline deposits in San Diego County. Such production has been classified under lithia.

PUMICE and VOLCANIC ASH.

Bibliography: State Mineralogist Reports XII, XIV (see 'Tufa'). Bulletin 38.

The production of pumice and volcanic ash for the year 1917 amounted to 525 tons, valued at $5,295, and came from Humboldt and Imperial counties. The material from Imperial County is the vesicular, block pumice, this being practically the only locality in the United States producing this class of rock at the present time; and is stated to have found a ready market. The Lipari Islands, Italy, have in the past been the principal source of supply of block pumice, but now largely shut off owing to the European war. There are other known deposits of such pumice in California, in Inyo, Madera, Mono and Siskiyou counties. From the last-named, near Mt. Shasta, some block pumice is now (1918), being shipped to Eastern points. The material from Inyo and Madera counties is the fine-grained, volcanic ash, or tuff variety. It is employed in making scouring soaps and polishing powders.

Commercial production of pumice in California was first reported to the State Mining Bureau in 1909, then not again until 1912, since which year there has been a small annual output, as indicated by the following table:

Year	Tons	Value	Year	Tons	Value
1909	50	$500	1915	380	$6,400
1910			1916	1,246	18,092
1911			1917	525	5,295
1912	100	2,500			
1913	3,590	4,500	Totals	5,941	$38,287
1914	50	1,000			

PYRITE.

Bibliography: Bulletin 38. Min. & Sci. Press, Vol. 114, pp. 825, 840.

Pyrite is mined for use in the manufacture of sulphuric acid, which in turn is being used in large quantities at the present time in the preparation of explosives. Experiments are being made as to the effect of sulphur, sulphuric acid, and SO_2 in the correction and fertilization of alkali soils. Two properties in Alameda County and one in Shasta report a total production in 1917 of 111,325 tons, valued at $323,704, which is a decrease from 1916.

This does not include the vast quantities of pyrite which are otherwise treated for their valuable metal contents. Some sulphuric acid is annually made as a by-product in the course of roasting certain tonnages of Mother Lode auriferous concentrates for their precious-metal values. California has, available, supplies of sulphide ores suitable for the manufacture of sulphuric acid far in excess of the local requirements; but the excess acid if made here is not of sufficient value per ton to pay the freight rates to Eastern markets. One of our large copper smelters here could, alone, flood the market with sulphuric acid from its copper ores roasted.

The total pyrite production in California to date is as follows:

Year	Tons	Value	Year	Tons	Value
1898	6,000	$30,000	1909	457,867	$1,389,802
1899	5,400	28,620	1910	42,621	179,862
1900	3,642	21,133	1911	54,225	182,954
1901	4,578	18,429	1912	69,872	203,470
1902	17,525	60,306	1913	79,000	218,537
1903	24,311	94,000	1914	79,267	230,058
1904	15,043	62,992	1915	92,462	293,148
1905	15,503	63,958	1916	120,525	372,969
1906	46,689	145,895	1917	111,325	323,704
1907	82,270	251,774			
1908	107,081	610,335	Totals	1,435,206	$4,781,996

SILICA—SAND and QUARTZ.

Bibliography: State Mineralogist Reports IX, XIV. Bulletins 38, 67.

We combine these materials, because of the overlapping roles of vein quartz which is mined for use in glass making and as an abrasive, and that of silica sand which, although mainly utilized in glass manufacture, also serves as an abrasive.

A portion of the tonnage of vein quartz in 1916 and 1917 was employed in the preparation of ferro-silicon by the electric furnace. Some also was utilized as a foundry flux.

The production of silica in 1917 amounted to 19,376 tons, valued at $41,166 from 13 properties in Amador, El Dorado, Kern, Los Angeles, Monterey, Riverside, Shasta and Tulare counties.

County	Tons	Value
Amador	4,771	$20,766
El Dorado	2,684	4,506
Riverside	770	2,400
Calaveras, Los Angeles, Monterey, Plumas, San Diego, Shasta*	11,151	13,494
Totals	19,376	$41,166

*Combined to conceal output of a single operator in each.

Of the above total, 5,326 tons were of vein and boulder quartz, and 14,050 tons, sand.

Practically all the glass sand produced in California occurs as such and needs no grinding. There are various deposits of quartz which could be utilized for glass making, but to date there has been only a small commercial production of this class of material.

Glass sand has been produced in the following counties of the state: Alameda, Amador, El Dorado, Los Angeles, Monterey, Orange, Placer, Riverside, San Joaquin, and Tulare. The chief producing centers have been Amador, Monterey and Los Angeles counties. The industry is of limited importance, so far, because of the fact that much of the available material is not of a grade which will produce first-class colorless glass.

Total silica production in California since the inception of the industry, in 1899, is shown below, being mainly glass sand:

Year	Tons	Value	Year	Tons	Value
1899	3,000	$3,500	1910	19,224	$18,265
1900	2,200	2,200	1911	8,620	8,672
1901	5,000	16,250	1912	13,075	15,404
1902	4,500	12,225	1913	18,618	21,899
1903	7,725	7,525	1914	28,538	22,688
1904	10,004	12,276	1915	28,904	34,322
1905	9,257	8,121	1916	20,880	48,908
1906	9,750	13,375	1917	19,376	41,166
1907	11,065	8,178			
1908	9,255	22,045	Totals	241,250	$342,536
1909	12,259	25,517			

SOAPSTONE and TALC.

Bibliography: State Mineralogist Reports XII, XIV. Bulletins 38, 67.

Soapstone—also called talc or steatite—occurs widely distributed throughout California. It is found as a hydration product in the alteration of magnesian silicates, and is often associated with serpentine and actinolite. But few deposits have been proven of especial value to date, although there is an undoubted future for this branch of the mineral industry in the state. Deposits of high grade white talc, the equal of the imported Italian article, are now being developed in Inyo and San Bernardino counties. It is used in making paper, toilet articles, soap, lubricants, tiling, etc., and for such is ordinarily ground to about 200 mesh before marketing. In this condition it brings $15 per ton and upwards, depending on quality. Commercially, the higher grades are called talc, and the lower, soapstone. Soapstone blocks are used in fireless cookers, electrical switchboards, laboratory table tops and laundry tubs; and the crushed material is used in roofing papers.

There was a total output in 1917 of 5,267 tons, valued at $45,279, from four producers in Inyo County and one each in the other counties. This is approximately a four-fold increase over the 1916 output.

County	Tons	Value
Inyo	4,736	$41,044
Amador, Los Angeles, San Bernardino, Tulare*	531	4,235
Totals	5,267	$45,279

*Combined to conceal output of a single mine in each.

Production has been intermittent in the state since 1893, as shown in the following table:

Year	Tons	Value	Year	Tons	Value
1893	400	$17,750	1907		
1894			1908	3	$48
1895	25	375	1909	33	280
1896			1910	740	7,260
1897			1911		
1898			1912	1,750	7,350
1899			1913	1,350	6,150
1900			1914	1,000	4,500
1901	10	119	1915	1,663	14,750
1902	14	288	1916	1,703	9.831
1903	219	10,124	1917	5,267	45,279
1904	228	2,315			
1905	300	3,000	Totals	14,705	$129,419
1906					

STRONTIUM.

Bibliography: Bulletin 67. U. S. G. S., Bull, 540; 660-I.

Production of strontium minerals in California in 1917 amounted to 3,050 tons, worth $37,000, from San Bernardino County, being mainly celestite ($SrSO_4$), but including also some carbonate, strontianite ($SrCO_3$). The first recorded commercial output of strontium minerals in California, was in 1916. The occurrence of the carbonate is particularly interesting and valuable, as it appears to be the first considerable deposit of commercial importance so far opened up in the United States. Shipments reported as averaging 80% $SrCO_3$ are being made. The deposit is associated with deposits of barite.

In addition to the Imperial County occurrence noted in our 1916 bulletin, celestite is also found near Calico, and in the Avawatz Mountains in San Bernardino County, but as yet undeveloped. The above output was converted to the nitrate.

It is estimated by the U. S. Geological Survey, that prior to 1914 about 2,000 tons of strontium nitrate was used in the manufacture of flares, or Costen and Bengal lights and fireworks. The demand has since increased considerably. Previously, the nitrate was imported from Germany, England and Sicily.

There is undoubtedly a good future for the strontium minerals in California, if the beet-sugar factories will take up their use, as has been done in Germany. Strontia is much more efficient and satisfactory in that process than lime, as it is stated to give an additional recovery of 6%–8% over lime. In Germany and Russia, about 100,000 tons of strontium hydroxide were used annually in the sugar industry.

Of the two minerals, strontianite is the more desirable, but scarcer.

Celestite is more abundant, and can be sold in large quantities at about $14-$18 per ton at the Atlantic seaboard. The carbonate is at present bringing $40-$50 per ton, crude, depending on quality. Celestite is found with limestones and sandstones and is sometimes associated with gypsum. Strontianite is also found with limestone, but associated with barite and calcite.

SULPHUR.

Bibliography: State Mineralogist Reports IV, XIII, XIV. Bulletins 38, 67.

There is, at present, no commercial output of native sulphur in California although this mineral has been found to some extent in Colusa, Imperial, Inyo, Kern, Lake, Mariposa, San Bernardino, Sonoma, Tehama, and Ventura counties. Operations were begun late in 1917, on a property in Inyo County, and some material stated to assay 40% sulphur was mined. Difficulties were encountered in refining it, so that no commercial production has as yet been made. There is some possibility of shipments being made in 1918 from Colusa County.

Sulphur was produced at the famous Sulphur Bank mine, in Lake County, during the years 1865–1868 (inc.), totaling 941 tons, valued at $53,500; following which the property became more valuable for its quicksilver. There has been no commercial yield of sulphur in California since that period.

About 37,000 tons of sulphur per year are imported to the United States from Japan, most of it coming in through the port of San Francisco.

CHAPTER SIX.

SALINES.

Under this heading are included borax, common salt, soda, potash and other alkaline salts. The first two have been produced in a number of localities in California, more or less regularly since the early sixties, although the State Mining Bureau kept no annual records of output previous to 1887. Except for a single year's absence, soda has had a continuous production since 1894. Potash, and magnesium chloride and sulphate have only recently been added to the commercial list, while the nitrates are still prospective.

Our main resources of salines are the lake beds of the desert regions of Imperial, Inyo, Kern, Los Angeles, San Bernardino, San Luis Obispo, and Siskiyou counties, and the waters of the Pacific Ocean.

The following tabulation shows amount and value of the saline minerals produced in California during the years 1916 and 1917, with increase in value for 1917 as compared with the previous year:

Substance	1916		1917		Increase (value)
	Tons	Value	Tons	Value	
Borax	103,523	$2,409,375	109,944	$2,561,958	$152,583+
Magnesium salts	851	6,407	1,064	34,973	28,566+
Potash	17,908	663,605	129,022	4,202,889	3,539,284+
Salt	186,148	455,695	227,825	584,373	128,678+
Soda	10,593	264,825	24,505	928,578	663,753+
Totals		$3,799,907		$8,312,771	$4,512,864+

BORAX.

Bibliography: State Mineralogist Reports III, X, XII, XIII, XIV, XV. Bulletins 24, 67.

Borax was first discovered in California in the waters of Tuscan Springs in Tehama County, January 8, 1856. Borax Lake, in Lake County, was discovered in September of the same year by Dr. John A. Veatch. This deposit was worked in 1864–1868, inclusive, and during that time produced 1,181,365 pounds of refined borax. This was the first commercial output of this salt in the United States, and California is still today the only American producer of borax.

Production from the dry lake or 'playa' deposits of Inyo and San Bernardino counties began in 1873; but it was not until 1887 that the borax industry was revolutionized by the discovery of the colemanite beds at Calico in San Bernardino County. These have since been

worked out, and the present output comes from similar beds in Inyo and Los Angeles counties. The colemanite deposits of Ventura County are at present unworked, owing to lack of transportation facilities.

During 1917 two producers reported a total output of 109,944 tons, valued at $2,561,958, compared with 103,523 tons, valued at $2,409,375, in 1916.

Value of the state's borax output since 1887 is shown in the following table:

Year	Value	Year	Value
1887	$116,689	1904	$698,810
1888	196,636	1905	1,019,158
1889	145,473	1906	1,182,410
1890	480,152	1907	1,200,913
1891	640,000	1908	1,117,000
1892	838,787	1909	1,163,960
1893	593,292	1910	1,177,960
1894	807,807	1911	1,456,672
1895	595,900	1912	1,122,713
1896	675,400	1913	1,491,530
1897	1,060,000	1914	1,483,500
1898	1,153,000	1915	1,663,521
1899	1,139,882	1916	2,409,375
1900	1,013,251	1917	2,561,958
1901	982,380		
1902	2,234,994	Total	$33,104,523
1903	661,400		

MAGNESIUM SALTS.

Magnesium chloride is an important item in certain chemical uses, and in the preparation of Sorel cement in laying magnesite floors. In the past, Germany has been the principal source of this chloride, which source is at the present time, of course, cut off. For this reason experiments have been made to prepare it by acid solution from magnesite, which is so abundant in California. Some of the salt companies began its commercial preparation in 1916, from the residual bitterns obtained during the evaporation of sea water for its sodium chloride.

In 1917, in addition to the chloride, some magnesium sulphate, or 'technical epsom salts,' was also made by one of the salt plants in Alameda County. This was sold to cotton goods manufacturers. The chloride sold for $20–$40 per ton, and the sulphate at $80–$90 per ton.

The 1917 output totaled 1064 tons, valued at $34,973, from Alameda, Los Angeles and San Mateo counties, compared with 851 tons and $6,407 in 1916.

Bitterns made at plants on San Francisco Bay carry 23 to 86 parts of magnesium per thousand, or 2.3% to 8.6% magnesium.[15]

[15] U. S. Dept. Agr. Bur. Soils, Bull. 94, p. 66, 1913.

Metallic magnesium is prepared electrolytically, utilizing generally an electrolyte of magnesium chloride and an alkaline chloride. Its commonest known use is in the powdered form for flashlights in photography. Its largest recent use is in the making of war munitions.[16]

It does not enter as an integral part into the explosives nor arms, but small quantities are put in shrapnel shells, that observers and gunners may know exactly where the shells are bursting. By day the burning magnesium gives a dense pure-white cloud of magnesium oxide, and at night a dazzling white light. Larger quantities are used in aerial bombs and rockets for lighting up the country at night. Magnesium has as yet found but a limited direct use as a metal. Magnalium, an alloy of aluminum containing about 2% of magnesium and small percentages of other metals, is stated to be used in automobiles and aeroplanes. The possibilities for further important developments in this direction are promising.

NITRATES.

Bibliography: Report XV. Bulletin 24.

Nitrates of sodium, potassium and calcium have been found in various places in the desert regions of the state, but no deposit of commercial value has been developed as yet. Interest in this class of mineral substance is increasing and closer search may be rewarded by workable discoveries. At present the principal commercial source of nitrates is the Chilean saltpeter deposits in South America.

The subject of the fixation of atmospheric nitrogen electrically is occupying a place in the public mind by reason of its success in Germany and Scandinavia. The possibilities of cheap hydroelectric power in California make the subject one of intense interest to us, as we have also the natural raw materials and chemicals to go with the power. Sodium and potassium cyanides can be made by fixation of atmospheric nitrogen electrically.

POTASH.

Bibliography: Bulletin 24. U. S. G. S., Min. Res. 1913, 1914, 1915. Senate Doc. No. 190, 62d Congress, 2d Session. Mining & Sci. Press, Vol. 112, p. 155; Vol. 114, p. 789.

Potash had not, previous to 1914, been produced commercially in California. Considerable money has been spent in the preliminary work incident to developing deposits of potash-bearing residues and brines in the old lake beds of the desert regions. The imports of potash salts and fertilizers from Germany previous to the European war had an annual value of several millions of dollars, and their cessation has made a domestic production imperative.

[16] U. S. G. S., Min. Res. 1915, Pt. I, p. 740.

The normal pre-war price of $35 to $40 per ton for high-grade agricultural salts has been succeeded by figures of several times those amounts; until in April, 1916, the chloride was nominally quoted at $425 per ton and the sulphate from $350 to $400 per ton. The approximate average selling price in 1917 at point of shipment for potash materials was $4.26 per unit, corresponding to $426 per ton of 100% K_2O.

During 1917 a total of 129,022 tons of potash-bearing material was produced in California, valued at $4,202,889. This is a several-fold increase over the 1916 output. It is, in part, refined potassium chloride and sulphate, kelp ash and dried kelp, varying in potash content from 80% K_2O for the refined salts down to 14% in the dried kelp; in part, refined sulphate and treater dust from several of the cement mills; and in part, concentrated salts from the brine of Searles Lake. Small tonnages of refined sulphate were also made from bitterns at two of the salt plants on San Francisco Bay. The yield from Los Angeles, San Diego and Santa Barbara counties is from the operations of kelp plants.

The bulk of this output was utilized in fertilizer preparations; but the product of at least one of the kelp plants was refined to the form of the nitrate for explosives manufacture. Some potassium iodide, also, was made, experimentally, and a commercial output is expected in 1918.

The large plant of the American Trona Corporation at Trona, on Searles Lake, San Bernardino County, began commercial operation in September, 1916, and continued in 1917 to ship crude potash salts to Eastern fertilizer works. These crude salts are stated to be made up of approximately 60% potassium chloride and 30% borax, with small amounts of other constituents. A second plant at Searles Lake has been built by the Solvay Process Company and began commercial operations in 1917.

In the cement mill of the Riverside Portland Cement Company, the fine dust from ball and tube mills is collected by a Cottrell electrical fume precipitator, the material showing an approximately 11% potash content. Some sulphate is being prepared from this, but the bulk of the tonnage sold goes to fertilizer manufacturers. Other cement plants have also commenced similar recovery of potash.

The following tabulation shows the distribution of the 1917 output of potash in California:

County	Tons	Value
Los Angeles	1,710	$400,902
San Bernardino	14,570	2,049,120
San Diego	5,252	1,492,123
Santa Barbara	974	126,830
Alameda, Imperial, Riverside, San Mateo, Santa Cruz*	106,516	133,914
Totals	129,022	$4,202,889

*Combined to conceal output of a single operator in each.

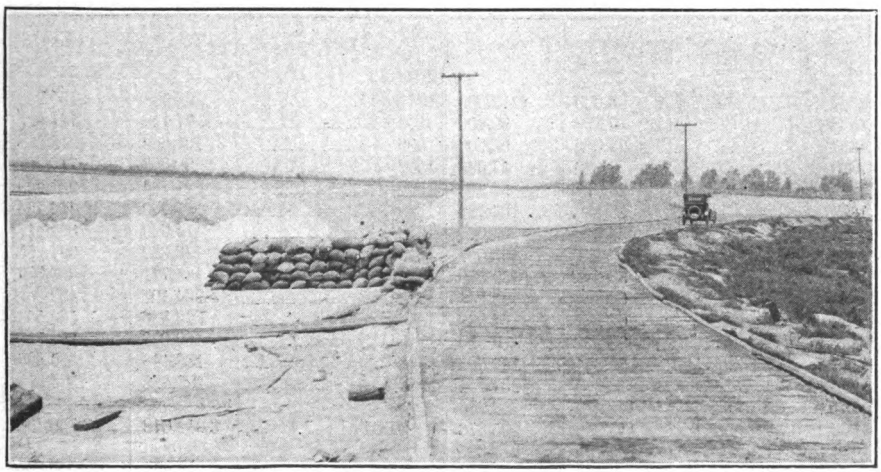
The annual amounts and values of these potash materials, since their beginning in California, are shown by the following table:

Year	Tons	Value
1914	10	$460
1915	1,076	19,391
1916	17,908	663,605
1917	129,022	4,202,889
Totals	148,016	$4,886,345

SALT.

Bibliography: State Mineralogist Reports II, XII, XIII, XIV. Bulletin 24.

Most of the salt produced in California is obtained by evaporating the waters of the Pacific Ocean, plants being located on the shores of



Salt stacks at plant of Oliver Chemical Company, Alameda County.

San Francisco Bay, at Long Beach, and on San Diego Bay. Additional amounts are derived from lakes and lake beds in the desert regions of the state. The salt production of San Bernardino County is derived from deposits of rock salt which are worked by means of quarrying and steam shovels. A small amount of valuable medicinal salts is annually obtained in Mono and Tehama counties, by evaporation from mineral springs.

Formerly a considerable proportion of the table salt consumed in California was shipped in from Eastern points; but, at present, California salt refineries supply not only our own markets but export a fair tonnage to other states and to Australia.

The 1917 output amounted to 227,825 tons, valued at $584,373, distributed as follows, by counties:

County	Tons	Value
Alameda	148,846	$315,970
San Diego	4,500	9,750
San Mateo	36,483	114,689
Inyo, Kern, Los Angeles, Mono, Monterey, San Bernardino, Solano*	37,996	143,964
Totals	227,825	$584,373

*Combined to conceal output of a single operator in each.

The above returns show an increase in both tonnage and value. There were 13 plants operating in Alameda, three in San Mateo, two in San Diego, and one in each of the other counties tabulated, a total of 540 men being employed.

Amount and value of annual production of salt in California from 1887 to date is shown in the following tabulation:

Year	Tons	Value	Year	Tons	Value
1887	28,000	$112,000	1904	95,968	$187,300
1888	30,800	92,400	1905	77,118	141,925
1889	21,000	63,000	1906	101,650	213,228
1890	8,729	57,085	1907	88,063	310,967
1891	20,094	90,303	1908	121,764	281,469
1892	23,570	104,788	1909	155,680	414,708
1893	50,500	213,000	1910	174,920	395,417
1894	49,131	140,087	1911	173,332	324,255
1895	53,031	150,576	1912	185,721	383,379
1896	64,743	153,244	1913	204,407	462,681
1897	67,851	157,520	1914	223,806	583,553
1898	93,421	170,855	1915	169,028	368,737
1899	82,654	149,588	1916	186,148	455,695
1900	89,338	204,754	1917	227,825	584,373
1901	126,218	366,376			
1902	115,208	205,876	Totals	3,212,613	$7,750,495
1903	102,895	211,365			

SODA.

Bibliography: State Mineralogist Reports XII, XIII, XV. Bulletins 24, 67.

The production of the carbonates and sulphate of sodium, in California in 1917, included: both the bicarbonate and soda ash from plants at Owens Lake; a natural carbonate from Dorris, Siskiyou County; sulphate from the natural brines at Searles Lake, San Bernardino County; and the natural sulphate from the Carrizo Plains, San Luis Obispo County. The shipments from San Bernardino, San Luis Obispo, and Siskiyou counties were the first recorded of these materials from those localities, on a commercial scale. The total tonnage was 24,505, valued at $928,578, of which 19,604 tons, valued at $861,160, came from the three plants in Inyo County.

These 'sodas' were used in the manufacture of glass, soap, and paper, as well as washing and baking soda, also in sugar refining.

The war has stimulated the chemical industry in the United States to produce materials that were formerly imported and to supply them to foreign countries, as well as to devise new uses for chemical products, also to replace more expensive by less expensive chemicals. Sodium compounds have replaced potassium compounds, either wholly or in part, in glass and soap making, in photography, in match making, in tanning, and in the manufacture of cyanide for extracting gold and silver from their ores.

The total output, showing amount and value of these materials in California since the inception of the statistical records of the State Mining Bureau, is given in the table which follows:

Year	Tons	Value	Year	Tons	Value
1894	1,530	$20,000	1907		
1895	1,900	47,500	1908	9,600	$14,400
1896	3,000	65,000	1909	7,712	11,593
1897	5,000	110,000	1910	8,125	11,862
1898	7,000	154,000	1911	9,023	52,887
1899	10,000	250,000	1912	7,200	37,094
1900	1,000	50,000	1913	1,861	24,936
1901	8,000	400,000	1914	6,522	115,396
1902	7,000	50,000	1915	5,799	83,485
1903	18,000	27,000	1916	10,593	264,825
1904	12,000	18,006	1917	24,505	928,578
1905	15,000	22,500			
1906	12,000	18,000	Totals	192,370	$2,777,056

CHAPTER SEVEN.

MINERAL PRODUCTION OF CALIFORNIA BY COUNTIES.

Introductory.

The state of California includes a total area of 158,360 square miles of which 155,980 square miles are of land. The maximum width is 235 miles, the minimum, 148 miles; and the length from the northwest corner to the southeast corner is 775 miles. The state is divided into fifty-eight counties. Some mineral of commercial value exists in every county, and during 1917 active production was reported to the State Mining Bureau from fifty-seven counties of the fifty-eight. In the mountainous portions of the state are found the vein-forming minerals, largely. In the desert regions of southeastern California ancient lake beds afford supplies of saline deposits. Underlying the interior valleys of the central and southern portion of the state are the large crude-oil reservoirs. Building stones and mineral earths of all descriptions are widely distributed throughout the length and breadth of the state.

Of the first ten counties in point of total output five (Kern, Orange, Fresno, Los Angeles, Santa Barbara) owe their position mainly to petroleum. Kern, due to its oil, leads all the others by over three times the total of Orange, its nearest competitor. Shasta owes its rank to copper, gold, zinc and silver; San Bernardino, its place on account of tungsten, potash, cement, copper; Inyo, mainly to borax, lead and soda; and the next six counties, Amador, Nevada, Yuba, Calaveras, Plumas, Sacramento, mainly to gold, except Plumas which is mainly copper and gold. Twenty-six counties have each a total in excess of a million dollars, for 1917. Cement is an important item in six of these counties.

In point of variety and diversity, San Bernardino County leads all the others with a total of 25 different mineral products on its commercial list; followed by Inyo with 17, and Shasta and Kern with 16 each.

The counties with their mineral resources, production for 1916, etc., are considered in detail in this chapter.

Value of California Mineral Production, by Counties, for 1917, Arranged in the Order of Their Importance.

County	Value	County	Value
1. Kern	$49,743,422	31. Sonoma	$506,750
2. Orange	15,231,626	32. San Joaquin	470,220
3. Fresno	14,158,052	33. Sierra	389,615
4. Shasta	10,244,869	34. Mariposa	352,227
5. Los Angeles	8,204,523	35. San Luis Obispo	338,144
6. San Bernardino	7,407,742	36. El Dorado	313,602
7. Inyo	6,296,230	37. Stanislaus	289,922
8. Santa Barbara	5,153,081	38. Marin	272,302
9. Amador	3,851,194	39. Madera	236,937
10. Nevada	3,838,397	40. Mono	218,772
11. Yuba	3,721,996	41. San Mateo	207,163
12. Calaveras	3,717,150	42. Lake	170,552
13. Plumas	2,294,886	43. Merced	147,116
14. Sacramento	2,286,656	44. Monterey	138,786
15. Solano	1,899,231	45. Imperial	129,400
16. San Diego	1,713,708	46. San Francisco	107,957
17. Santa Cruz	1,668,324	47. Del Norte	104,340
18. Riverside	1,580,555	48. Glenn	65,272
19. Tulare	1,499,988	49. Humboldt	59,858
20. Ventura	1,498,010	50. Mendocino	50,415
21. Napa	1,421,073	51. Tehama	44,019
22. Contra Costa	1,276,657	52. Colusa	16,321
23. San Benito	1,233,163	53. Yolo	5,561
24. Alameda	1,138,723	54. Sutter	5,000
25. Butte	1,130,259	55. Kings	2,777
26. Placer	1,029,789	56. Lassen	376
27. Santa Clara	991,530	57. Modoc	200
28. Trinity	987,842	58. Alpine	----
29. Siskiyou	829,409		
30. Tuolumne	511,273	Total	$161,202,962

ALAMEDA.

Area: 843 square miles.

Population: 359,000 (estimate by Chamber of Commerce, 1914).

Alameda County, while in no sense one of the 'mining counties,' comes twenty-fourth on the list with a value of mineral products for 1917 of $1,138,723, an increase from the 1916 total, which was $1,094,723. The mineral resources of this county include asbestos, brick, chromite, clay, coal, limestone, magnesite, manganese, pyrite, salt, soapstone, and miscellaneous stone.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	52 tons	$960
Brick and tile	----	290,033
Clay (pottery)	6,502 tons	4,524
Manganese	1,211 tons	30,250
Salt	148,846 tons	315,970
Stone, miscellaneous	----	413,845
Other minerals*	----	83,141
Total value	----	$1,138,723

*Includes lime, limestone, magnesite, magnesium salts, potash and pyrite.

ALPINE.

Area: 776 square miles.

Population: 309 (1910 census).

Alpine has in the past shown a small production of gold and silver, but dropped out of the list of producing counties in 1914..

This county lies just south of Lake Tahoe, in the high Sierra Nevada range of mountains. Transportation is by wagon or mule back, and facilities in general are lacking to promote development work of any kind.

The mineral resources of this section are varied and the country has not yet been thoroughly prospected. Occurrences of barium, copper, gold, gypsum, lead, limestone, pyrite, rose quartz, silver, tourmaline, and zinc have been noted here.

AMADOR.

Area: 601 square miles.

Population: 11,000 (estimate by County Clerk, 1914).

The value of Amador County's mineral production increased slightly from $3,811,428, in 1916, to $3,851,194, but retaining ninth place on the list of counties in the state as regards total value of mineral substances marketed.

Although having an output consisting of 14 different minerals, the leading product, gold, makes up over 95% of the entire total. Amador led the state in gold production in 1915, but was slightly exceeded in 1917 by Nevada and Yuba counties.

The mineral resources of this county include asbestos, brick, chromite, clay, coal, copper, gold, lime, quartz crystals, glass-sand, sandstone, silver, soapstone, and miscellaneous stone.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	65 tons	$1,420
Brick and tile		95,345
Clay (pottery)	28,970 tons	28,625
Copper	19,352 lbs.	5,283
Gold		3,664,164
Silica	4,771 tons	20,766
Silver		21,358
Stone, miscellaneous		1,200
Other minerals*		13,033
Total value		$3,851,194

*Includes coal, lead, manganese, platinum, soapstone, and zinc.

BUTTE.

Area: 1,722 square miles.
Population: 31,000 (estimate by Chamber of Commerce, 1914).
Location: North central portion of state.

Butte, twenty-fifth county in California in regard to the value of its mineral output, reported a commercial production of eleven mineral substances, having a total value of $1,130,259 as compared with $1,356,925 for 1916, the decrease being due to gold. As will be noted in the following tabulation, gold is by far the most important item. Butte stands sixth among the gold-producing counties of the state. Among the mineral resources of this section are asbestos, barytes, chromite, gems, gold, limestone, marble, mineral water, platinum minerals, silver, and miscellaneous stone.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	5,746 tons	$104,085
Gems		125
Gold		922,271
Lead	378 lbs.	32
Mineral water	3,500 gals.	1,450
Platinum	119 ounces	9,106
Silver		2,991
Stone, miscellaneous		89,870
Other minerals*		329
Total value		$1,130,259

*Includes copper, manganese, and natural gas.

CALAVERAS.

Area: 1,027 square miles.
Population: 9,171 (1910 census).
Location: East central portion of state—Mother Lode district.

Calaveras County reported production of 13 different minerals, valued at $3,717,150, during the year 1917, as compared with the 1916 output worth $2,965,592. Gold, copper and silver are the chief mineral substances produced. In regard to total value of mineral output Calaveras stands twelfth among the counties of the state; it is fifth in gold, second in copper, and third in silver. The increase in 1917 was due mainly to copper.

The principal mineral resources developed and undeveloped are: Asbestos, barytes, chromite, clay, copper, fuller's earth, gold, graphite, limestone, magnesite, marble, mineral paint, mineral water, platinum minerals, pyrite, quartz crystals, silver, soapstone, and miscellaneous stone.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	1,613 tons	$34,245
Copper	7,720,861 lbs.	2,107,795
Gold		1,471,442
Lead	6,395 lbs.	550
Mineral water	16,985 gals.	7,009
Platinum	20 ounces	1,433
Silver		87,984
Stone, miscellaneous		2,700
Other minerals*		3,992
Total value		$3,717,150

*Includes clay-pottery, fuller's earth, mineral paint, silica, and zinc.

COLUSA.

Area: 1,140 square miles.

Population: 7,882 (estimate by Chamber of Commerce, 1914).

Location: Sacramento Valley.

Colusa County lies largely in the basin of the Sacramento Valley. Its western border, however, rises into the foothills of the Coast Range of mountains, and its mineral resources—largely undeveloped—include coal, chromite, copper, gypsum, manganese, mineral water, pyrite, quicksilver, sandstone, miscellaneous stone, sulphur, and in some places traces of gold and silver.

The value of the 1917 production was $16,321, a decrease from the 1916 figures of $42,803, giving it fifty-second place.

Substance	Amount	Value
Stone, miscellaneous		$600
Other minerals*		15,721
Total value		$16,321

*Includes mineral paint, and mineral water.

CONTRA COSTA.

Area: 714 square miles.

Population: 52,500 (estimate by Chamber of Commerce, 1914).

Contra Costa, like Alameda County, lies on the eastern shores of San Francisco Bay, and is not commonly considered among the mineral-producing counties of the state. It stands seventeenth on the list in this respect, however, with an output valued at $1,276,657 for the calendar year 1917. Various structural materials make up the chief items,

including brick, cement, limestone, and miscellaneous stone. Among the others are asbestos, clay, coal, gypsum, manganese, mineral water and soapstone.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Brick and tile		$172,653
Mineral water	436,265 gals.	8,563
Stone, miscellaneous		322,507
Other minerals*		772,934
Total value		$1,276,657

*Includes cement and coal.

DEL NORTE.

Area: 1,024 square miles.
Population: 2,417 (1910 census).
Location: Extreme northwest corner of state.
Transportation: Wagon and mule back; steamer from Crescent City.

Del Norte rivals Alpine County in regard to inaccessibility. Like the latter county also, given transportation and kindred facilities, this portion of the state presents a wide field for development along mining lines especially. Its chief mineral resources, largely untouched, are chromite, copper, gems, gold, graphite, iron, platinum minerals, silver, and miscellaneous stone. The increase in 1917 over the 1916 figure of $2,432 was due to chromite.

Commercial production for 1917, giving it forty-seventh place, was as follows:

Substance	Amount	Value
Chromite	3,275 tons	$97,255
Gold		1,373
Platinum	10 ounces	853
Silver		8
Stone, miscellaneous		2,700
Other minerals		2,151
Total value		$104,340

EL DORADO.

Area: 1,753 square miles.

Population: 8,000 (estimate by County Clerk, 1914).

Location: East central portion of the state; northernmost of the Mother Lode counties.

El Dorado County, which contains the locality where gold in California was first heralded to the world, comes thirty-sixth on the list of counties ranked according to the value of their total mineral production during the year 1917. In addition to the segregated figures here given, a large tonnage of limestone is annually shipped from El Dorado for use in cement manufacture, and whose value is included in the state total for cement. The output of chromite showed an important increase for 1917.

The mineral resources of this section, many of them undeveloped, include asbestos, barytes, chromite, clay, copper, gems, gold, iron, molybdenum, limestone, quartz crystals, quicksilver, glass-sand, slate, soapstone, silver and miscellaneous stone.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	8,319 tons	$167,950
Copper	18,982 lbs.	5,182
Gold		24,758
Lime and limestone		104,851
Silica	2,684 tons	4,506
Silver		85
Stone, miscellaneous		6,200
Other minerals		70
Total value		$313,602

FRESNO.

Area: 5,950 square miles.

Population: 120,000 (estimate by Board of Supervisors, 1914).

Location: South central portion of state.

Fresno County, third in importance as a mineral producer among the counties of California, reported an output for 1917 of thirteen mineral substances, with a total value of $14,158,052, an increase over the reported 1916 production, which was worth $8,061,193. The great bulk of the above value is derived from the petroleum production of the Coalinga field. In 1917, in company with Orange County, Fresno passed Shasta County, which had previously exceeded all others except Kern.

The mineral resources of this county are many, and, aside from crude oil, are not yet fully developed. They include asbestos, barytes, brick, chromite, copper, gems, gold, graphite, gypsum, iron, magnesite, natural gas, petroleum, quicksilver, silver, and miscellaneous stone.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	6,289 tons	$109,292
Copper	40,662 lbs.	11,101
Gold		5,745
Granite		31,500
Magnesite	6,077 tons	57,422
Natural gas	4,097,626 M cu. ft.	347,501
Petroleum	16,259,797 bbls.	13,414,333
Silver		289
Stone, miscellaneous		136,719
Other minerals*		44,150
Total value		$14,158,052

*Includes asbestos, brick, mineral water and quicksilver.

GLENN.

Area: 1,259 square miles.

Population: 7,172 (1910 census).

Glenn County, standing forty-eighth, owes its position among the mineral-producing counties of the state mainly to the presence of large deposits of sand and gravel which are annually worked, the product being used for railroad ballast, etc. In 1917, chromite was also an important item. In the foothills in the western portion of the county, deposits of chromite, copper, manganese, sandstone, and soapstone have been found.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	879 tons	$21,474
Manganese	369 tons	9,721
Stone, miscellaneous		33,260
Other minerals		817
Total value		$65,272.

HUMBOLDT.

Area: 3,634 square miles.

Population: 37,500 (estimate by Chamber of Commerce, 1914).

Location: Northwestern portion of state, bordering on Pacific Ocean.

Humboldt County is almost entirely mountainous, transportation within its limits being very largely by wagon road and trail, and until recent years was reached from the outside world by steamer only. The county is rich in mineral resources, among which are brick, chromite, coal, clay, copper, gold, iron, mineral water, natural gas, petroleum, platinum, silver, and miscellaneous stone.

Nine mineral substances, as shown by the table given below, having a total value of $59,808, were produced in 1917, as compared with the 1916 output, worth $274,895, the decrease being due to the smaller amount of stone being used on the Eureka Harbor breakwater. Humboldt ranks forty-ninth among the counties of the state for the year.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Gold		$23,086
Platinum	6 ounces	351
Silver		95
Stone, miscellaneous		27,014
Other minerals*		9,312
Total value		$59,858

*Includes brick, clay, mineral water, natural gas, and volcanic ash.

IMPERIAL.

Area: 4,089 square miles.

Population: 50,000 (estimate by Chamber of Commerce, 1914).

Location: Extreme southeast corner of the state.

During 1917 Imperial County produced eight mineral substances having a total value of $129,400, as compared with the 1916 output, worth $105,333. Its rank is forty-fifth. This county contains deposits of gold, gypsum, lead, marble, pumice, salt, silver, and strontium, largely undeveloped.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Brick and tile		$19,260
Gold		919
Manganese	1,907 tons	38,140
Silver		5
Stone, miscellaneous		65,660
Other minerals*		5,416
Total value		$129,400

*Includes copper, potash, and pumice.

INYO.

Area: 10,019 square miles.

Population: 7,500 (estimate by Chamber of Commerce, 1914).

Location: Lies on eastern border of state, north of San Bernardino County.

Inyo, the second largest county in the state, and containing less than one inhabitant per square mile, is extremely interesting from a mineralogical point of view. It is noted because of the fact that within its borders are located both the highest point, Mount Whitney (elevation 14,502 feet), and the lowest point, Death Valley (elevation 290 feet below sea level), in the United States. In the higher mountainous sections are found many vein-forming minerals, and in the lake beds of Death Valley saline deposits exist.

Inyo's mineral production during the year 1917 reached a value of $6,296,230, standing seventh among the counties of the state in this respect. The 1916 value was $4,600.090, the increase being due to lead, borax, silver, tungsten and soda. Its mineral resources include antimony, asbestos, barytes, bismuth, borax, copper, gems, gold, gypsum, lead, magnesite, marble, molybdenum, mineral water, nitre, platinum, pumice, quicksilver, salt, silver, soda, sulphur, talc, tungsten, and zinc.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Copper	175,273 lbs.	$47,850
Dolomite	11,315 tons	22,630
Gold		125,394
Lead	19,318,642 lbs.	1,661,403
Talc	4,736 tons	41,044
Soda	19,604 tons	861,160
Silver		534,599
Stone, miscellaneous		3,000
Zinc	3,525,004 lbs.	359,550
Other minerals*		2,639,600
Total value		$6,296,230

*Includes asbestos, barytes, borax, gypsum, marble, molybdenum, salt, and tungsten concentrates.

KERN.

Area: 8,003 square miles.

Population: 50,000 (estimate by Board of Supervisors).

Location: South central portion of state.

Kern County, because of its immense, productive oil fields, stands pre-eminent among all counties of California in the value of its mineral output, the exact figures for 1917 being $49,743,422. This is larger by more than thirty-four million dollars than the succeeding county on the list. This figure also is nearly 2½ times the value of the total gold output of the entire state for 1917. The 1916 mineral output for Kern County was worth $37,826,907. The great increase was due to the enhanced prices for crude oil of all grades.

Among the mineral resources, developed and undeveloped, of this section are: Antimony, asbestos, asphalt, barytes, borax, brick, clay, copper, fuller's earth, gems, gold, gypsum, iron, lead, limestone, magnesite, marble, mineral paint, natural gas, petroleum, potash, salt, silver, soapstone, soda, sulphur, and tungsten.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Antimony	113 tons	$16,041
Brick and tile		22,785
Copper	251,225 lbs.	68,584
Gold		537,852
Lead	9,684 lbs.	833
Natural gas	25,819,376 M cu. ft.	1,445,880
Petroleum	53,065,066 bbls.	47,387,104
Quicksilver	300 flasks	27,250
Silver		7,813
Stone, miscellaneous		31,787
Tungsten concentrates	49 tons	58,148
Other minerals*		139,345
Total value		$49,743,422

*Includes clay, feldspar, lime, limestone, magnesite, and salt.

KINGS.

Area: 1,159 square miles.

Population: 23,500 (estimate by Chamber of Commerce, 1914).

Location: South-central portion of the state.

Little development has taken place in Kings County along mineral lines to date. Deposits of fuller's earth, gypsum, mineral paint, natural gas, and quicksilver, of undetermined extent, have been found in the county. Some drilling for oil has been under way.

In fifty-fifth place, commercial production for 1917 was as follows:

Substance	Amount	Value
Natural gas	3,569 M cu. ft.	$2,777

LAKE.

Area: 1,278 square miles.

Population: 5,600 (estimate by Chamber of Commerce, 1914).

Location: About fifty miles north of San Francisco Bay and the same distance inland from the Pacific Ocean.

On account of its topography and natural beauties, Lake County is sometimes referred to as the Switzerland of America. The mineral resources which exist here are many and varied, actual production being comparatively small, as shown by the table below, and composed mainly of quicksilver, chromite and mineral water. Some of the leading minerals found in this section, in part as yet undeveloped, are borax, chromite, clay, copper, gems, gold, gypsum, mineral water, quicksilver, silver, and sulphur.

In forty-second place, commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	1,466 tons	$36,326
Manganese	85 tons	1,900
Mineral water	129,157 gallons	22,685
Quicksilver	1,067 flasks	107,071
Stone, miscellaneous		2,500
Other minerals		70
Total value		$170,552

LASSEN.

Area: 4,531 square miles.

Population: 7,000 (estimate by County Clerk, 1914).

Location: Northeast portion of state.

Lassen County is one of the little explored sections of California. Since about 1912 a railroad traversing the county north and south has been in operation, thus affording opportunity for development along mineral and other lines.

Among the mineral resources of this county are copper, gems, gypsum, gold, silver, and sulphur. In the past, some gold has been produced, but not during the last two or three years.

In fifty-sixth place, commercial production for 1917 was as follows:

Substance	Amount	Value
Stone, miscellaneous		$376

LOS ANGELES.

Area: 4,067 square miles.

Population: 800,000 (estimate by Chamber of Commerce, 1913).

Mineral production in Los Angeles County for the year 1917 amounted in value to $8,204,523, as compared with the 1916 output, worth $4,463,523. This county ranked fifth in the state as a mineral producer in 1917, the advance being due to the large increase in the petroleum valuation.

Its output of brick and tile was nearly a million dollars, and that of petroleum amounted to over five million dollars. Among its mineral resources may be noted asphalt, barytes, borax, brick, clay, fuller's earth, gems, gold, gypsum, infusorial earth, limestone, marble, mineral paint, mineral water, natural gas, petroleum, salt, glass-sand, sandstone, serpentine, silver, soapstone, and miscellaneous stone. Some potash is obtained from kelp.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Brick and tile		$939,081
Clay—pottery	6,276 tons	10,321
Gems		300
Mineral water	188,368 gallons	16,902
Natural gas	1,670,476 M cu. ft.	194,793
Petroleum	4,669,583 bbls.	5,491,430
Potash	1.710 tons	400,902
Stone, miscellaneous		608,026
Other minerals*		542,768
Total value		$8,204,523

*Includes borax, graphite, magnesium chloride, salt, silica, serpentine and talc.

MADERA.

Area: 2,112 square miles.

Population: 12,000 (estimate by Chamber of Commerce, 1914).

Location: East-central portion of state.

Madera County produced six mineral substances during the year 1917, having a total value of $236,937, as compared with the 1916 output, worth $222,758. This county contains deposits of copper, gold, iron, lead, molybdenum, pumice, silver and building stone.

In thirty-ninth place, commercial production for 1917 was as follows:

Substance	Amount	Value
Copper	372,123 lbs.	$101,590
Gold		18,914
Granite		114,400
Lead	221 lbs.	19
Silver		489
Stone, miscellaneous		1,525
Total value		$236,937

MARIN.

Area: 529 square miles.

Population: 28,400 (estimate by Chamber of Commerce, 1914).

Location: Adjoins San Francisco on the north.

Mineral production in Marin County during the year 1917 reached a value of $272,302, as compared to the 1916 output, worth $178,306. This county is not especially prolific in minerals, although among its resources along these lines are brick, gems, manganese, mineral water, soapstone, and miscellaneous stone.

In thirty-eighth place, commercial production for 1917 was:

Substance	Amount	Value
Stone, miscellaneous		$158,582
Other minerals*		113,720
Total value		$272,302

*Includes brick and mineral water.

MARIPOSA.

Area: 1,463 square miles.

Population: 3,956 (1910 census).

Location: Most southerly of the Mother Lode counties. East-central portion of state.

Mariposa County is one of the distinctly 'mining' counties of the state, although it stands but thirty-fourth on the list of counties in regard to the value of its mineral output for 1917, with a total of $352,227, as compared with the 1916 figures of $487,971. The decrease is due to gold.

Its mineral resources are varied; among the more important items being barytes, copper, gems, gold, lead, marble, silver, slate, soapstone, and miscellaneous stone.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Copper	53,381 lbs.	$14,583
Gold		313,296
Lead	1,075 lbs.	92
Silver		3,221
Stone, miscellaneous		7,646
Other minerals		13,399
Total value		$352,237

MENDOCINO.

Area: 3,453 square miles.

Population: 27,000 (estimate by Chamber of Commerce, 1914).

Location: Joins Humboldt County on the south and bounded by the Pacific Ocean on the west.

Mendocino's annual mineral production is small, the 1917 output being valued at $50,415, ranking it fiftieth among the counties. That of 1916 was worth $55,680. The principal item is manganese.

Deposits of undetermined value, of asbestos, chromite, coal, copper, graphite, magnesite, and mineral water have been found, as well as traces of gold and silver. For the coming year there are good prospects for a continued commercial yield of manganese ore.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Manganese	1,541 tons	$40,515
Stone, miscellaneous		5,600
Other minerals*		4,300
Total value		$50,415

*Includes chromite, brick and magnesite.

MERCED.

Area: 1,995 square miles.

Population: 20,000 (estimate by Chamber of Commerce, 1914).

Location: About the geographical center of the state.

Merced County as a whole lies in the San Joaquin Valley, and it figures as one of the lesser mineral-producing counties of the state. The 1917 mineral output was valued at $147,116. The increase over the value of $81,530 in 1916 was due to crushed rock and gravel. Gold, platinum and silver, obtained by dredging, are among the important items. Undeveloped deposits of antimony, magnesite, quicksilver, and limestone have been noted in this county in addition to the foregoing.

In forty-third place, commercial production during 1917 was as follows:

Substance	Amount	Value
Stone, miscellaneous		$70,500
Other minerals*		76,616
Total value		$147,116

*Includes gold, platinum and silver.

MODOC.

Area: 3,823 square miles.

Population: 6,191 (1910 census).

Location: The extreme northeast corner of the state.

Modoc County, like Lassen, has only recently had the benefit of communication with the outside world by rail. Among its known mineral resources are: Clay, coal, gold, iron, quicksilver, salt, and silver.

In fifty-seventh place, commercial production for 1917 was as follows:

Substance	Amount	Value
Stone, miscellaneous		$200

MONO.

Area: 3,030 square miles.

Population: 2,100 (estimate by County Clerk, 1914).

Location: Is bordered by the state of Nevada on the east and is about in the central portion of the state measured on a north and south line.

Gold mining has been carried on in portions of Mono County for many years, although taken as a whole it lies in a rather inaccessible country and has been but superficially explored. It is in the continuation of the highly mineralized belt which was noted in Inyo County and contains among other mineral resources barytes, clay, copper, gold, limestone, molybdenum, pumice, salt, silver, and travertine.

In fortieth place, commercial production for 1917 was as follows:

Substance	Amount	Value
Gold		$209,040
Lead	1,912 lbs.	164
Silver		5,662
Other minerals*		3,906
Total value		$218,772

*Includes copper, molybdenum and salt.

MONTEREY.

Area: 3,330 square miles.

Population: 25,250 (estimate by Chamber of Commerce, 1914).

Location: West central portion of state, bordering on Pacific Ocean.

Monterey County produced nine mineral substances during the year 1917, having a total value of $138,786, as compared with the 1916 output worth $109,872, the increase being due mainly to dolomite and quicksilver. Its mineral resources include brick, clay, copper, coal, dolomite, feldspar, fuller's earth, gold, silver, gypsum, infusorial earth, limestone, mineral water, petroleum, quicksilver, glass-sand, sandstone, silver, and miscellaneous stone.

In forty-fourth place, commercial production for 1917 was as follows:

Substance	Amount	Value
Dolomite	6,392 tons	$23,468
Stone, miscellaneous		57,810
Other minerals*		57,508
Total value		$138,786

*Includes barytes, infusorial earth, limestone, mineral water, quicksilver, salt, and silica.

NAPA.

Area: 783 square miles.

Population: 26,500 (estimate by Chamber of Commerce, 1914).

Location: Directly north of San Francisco Bay—one of the 'bay counties.'

Napa, because of its production of structural and industrial materials and quicksilver, stands twenty-first on the list of mineral-producing counties in California. Its mineral resources include copper, cement, gypsum, magnesite, mineral water, quicksilver, sandstone, and miscellaneous stone.

In 1917, the value of the output increased to $1,421,073 from the 1916 figure of $1,078,537, due mainly to magnesite and cement.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	844 tons	$22,020
Magnesite	40,329 tons	387,930
Mineral water	126,124 gallons	70,058
Quicksilver	834 flasks	78,320
Stone, miscellaneous		110,039
Other minerals*		752,706
Total value		$1,421,073

*Includes cement, clay, and copper.

NEVADA.

Area: 974 square miles.

Population: 15,500 (estimate by Chamber of Commerce, 1914).

Location: North of Lake Tahoe, on the eastern border of the state.

Nevada, one of the mountain counties of California, led all others in its gold output for 1917. Nevada County stands tenth on the list in regard to the value of its total mineral output, with a figure of $3,838,397, as compared with the 1916 production worth $3,744,143. The increase is due mainly to chromite, tungsten and gold.

While this county actually produces mainly gold and silver, its resources cover a wide scope, including antimony, asbestos, barytes, bismuth, chromite, clay, copper, gems, iron, lead, mineral paint, pyrite, soapstone, and tungsten.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	1,962 tons	$43,449
Copper	40,165 lbs.	10,965
Gold		3,682,947
Silver		52,335
Stone, miscellaneous		1,600
Other minerals*		47,101
Total value		$3,838,397

*Includes asbestos, lead, platinum, and tungsten concentrates.

ORANGE.

Area: 795 square miles.

Population: 56,500 (estimate by Chamber of Commerce, 1914).

Location: Southwestern portion of state, bordering Pacific Ocean.

Orange County is one of the many in California which on casual inspection appears to be anything but a mineral-producing section. It stands, however, as the second county in the state in regard to the total value of mineral output for 1917, its highly productive oil fields making such a condition possible.

This county, in company with the other oil counties, shows a gain in 1917, with a total value of mineral products of $15,231,626, from the 1916 output, worth $8,905,086. It thus passed Shasta County in 1917, which previously for a number of years, had exceeded all other counties in California, except Kern.

Aside from the substances actually produced and noted in the table below, coal, gypsum, iron, infusorial earth, sandstone, and tourmaline have been found in Orange County.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Brick and tile		$11,000
Natural gas	8,171,835 M cu. ft.	490,511
Petroleum	14,680,801 bbls.	14,724,843
Stone, miscellaneous		2,699
Other minerals*		2,573
Total value		$15,231,626

*Includes clay-pottery, copper and lead.

PLACER.

Area: 1,395 square miles.

Population: 18,237 (1910 census).

Location: Eastern border of state directly west of Lake Tahoe.

While standing only twenty-sixth on the list of mineral-producing counties, Placer contains a wide variety of mineral substances, some of which have not been commercially exploited. Its leading products are gold, chromite, granite, copper, and clay. Other mineral resources are: Asbestos, brick, chromite, coal, gems, iron, lead, limestone, magnesite, manganese, marble, quartz crystals, glass-sand, silver, and miscellaneous stone.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	4,287 tons	$105,384
Clay—pottery	44,097 tons	44,097
Copper	710,601 lbs.	193,994
Gold		538,686
Granite		30,392
Silver		13,885
Stone, miscellaneous		10,727
Other minerals*		92,624
Total value		$1,029,789

*Includes asbestos, brick and tile, gems, magnesite, and platinum.

PLUMAS.

Area: 2,594 square miles.

Population: 5,259 (1910 census).

Location: Northeastern border of state, south of Lassen County.

A considerable portion of the area of Plumas County lies in the high mountains, and deposits of the metals, especially gold and copper, are found there. Lack of transportation and other facilities have retarded its growth, but its future is decidedly promising. Mineral production

for 1917 was valued at $2,294,886, as compared with the 1916 output, worth $1,399,335, the increase being due to copper, and silver.

Among its mineral resources are: Chromite, copper, gold, granite, iron, lead, limestone, manganese, platinum, silver, tungsten, and zinc.

In thirteenth place, commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	473 tons	$9,800
Copper	7,462,870 lbs.	2,037,364
Gold		131,955
Manganese	1,540 tons	39,680
Silver		74,461
Stone, miscellaneous		1,322
Other minerals*		304
Total value		$2,294,886

*Includes gems, granite, and silica.

RIVERSIDE.

Area: 7,240 square miles.

Population: 45,000 (estimate by County Clerk, 1914).

Location: Southern portion of state.

Riverside is the fourth county in the state in size and the eighteenth in regard to the total value of mineral output for 1917. Within its borders are included mountain, desert, and agricultural land. Its mineral resources include metals, structural and industrial materials, and salines, some of the more important being borax, brick, cement, clay, coal, copper, feldspar, gems, gold, gypsum, iron, lead, limestone, manganese, magnesite, marble, mineral paint, mineral water, salt, glass-sand, soapstone, silver, miscellaneous stone, and tin.

The increase in 1917 over the 1916 value of $1,234,252 is due mainly to cement and potash.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Brick and tile		$165,892
Clay—pottery	70,798 tons	55,491
Copper	28,838 lbs.	7,873
Feldspar	11,097 tons	42,900
Granite		3,461
Gypsum	1,923 tons	3,001
Lead	1,157 lbs.	100
Silica	770 tons	2,400
Stone, miscellaneous		72,364
Other minerals*		1,227,073
Total value		$1,580,555

*Includes cement, fluorspar, gems, magnesite, manganese, mineral water, potash, and silver.

SACRAMENTO.

Area: 983 square miles.

Population: 90,000 (estimate by Chamber of Commerce, 1913).

Location: North-central portion of state.

Sacramento stands fourteenth among the counties of the state as a mineral producer, the output, principally gold, for 1917 being valued at $2,286,656, as compared with the 1916 production, worth $2,178,674. In regard to gold output alone this county ranks fourth, being exceeded only by Nevada, Amador, and Yuba counties. Its mineral resources include: Brick, clay, gold, natural gas, platinum, silver, and miscellaneous stone.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Brick and tile		$122,886
Clay—pottery	310 tons	410
Gold		1,919,581
Platinum	157 ounces	12,453
Silver		4,487
Stone, miscellaneous		199,839
Other minerals		27,000
Total value		$2,286,656

SAN BENITO.

Area: 1,392 square miles.

Population: 8,750 (estimate by County Clerk, 1914).

Location: West-central portion of state.

Although twenty-third among the counties of the state in regard to value of total mineral production, San Benito leads in one important branch of the mineral industry; namely, quicksilver.

Its other mineral resources, many of them undeveloped, include: Antimony, bituminous rock, chromite, coal, gypsum, gems, limestone, mineral water, soapstone, and miscellaneous stone.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Dolomite	7,000 tons	$15,000
Quicksilver	11,150 flasks	1,057,770
Stone, miscellaneous		101,148
Other minerals*		59,245
Total value		$1,233,163

*Includes antimony, chromite, magnesite and mineral water.

SAN BERNARDINO.

Area: 20,157 square miles.

Population: 53,000 (estimate by board of supervisors, 1914).

Location: Southeastern portion of state.

San Bernardino, by far the largest county in the state, in area, ranks sixth as regards the value of its mineral output for 1917 with a total of $7,407,742, as compared with the 1916 total of $6,569,147. The increase is due mainly to potash and cement, in spite of the considerable decrease in tungsten value.

San Bernardino leads all other counties in the state in point of variety of minerals produced commercially during 1917, there being 25 different substances on its list, against 17 for its nearest competitor, Inyo County.

This county, consisting largely of mountain and desert country, is highly mineralized, the following being included among its resources: Asbestos, barytes, borax, brick, cement, clay, copper, gems, gold, granite, gypsum, iron, lead, limestone, manganese, marble, mineral paint, mineral water, nitre, potash, salt, glass-sand, silver, soapstone, soda, miscellaneous stone, strontium, talc, tungsten, vanadium and zinc.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Cement	1,323,931 bbls.	$1,672,054
Copper	1,220,356 lbs.	333,157
Gold		154,976
Granite		2,350
Lead	2,293,541 lbs.	197,245
Lime and limestone		187,571
Manganese	235 tons	6,050
Mineral water	11,300 gallons	1,620
Potash	14,570 tons	2,049,120
Silver		88,930
Stone, miscellaneous		111,158
Strontium	3,050 tons	37,000
Tungsten concentrates	1,943 tons	2,447,726
Zinc	38,735 lbs.	3,951
Other minerals*		114,834
Total value		$7,407,742

*Includes brick, clay-pottery, dolomite, feldspar, gems, gypsum, iron, mineral paint, salt, soda and talc.

SAN DIEGO.

Area: 4,221 square miles.

Population: 125,379 (estimate by County Clerk, 1914).

Location: Extreme southwest corner of state.

San Diego, first in California in the production of gem stones, ranks sixteenth in the total value of its mineral output. This figure for 1917 equaled $1,713,708, as compared to the 1916 output worth $397,168,

the advance being due to potash and copper. Aside from minerals commercially produced, as shown below, San Diego County contains occurrences of bismuth, lithia, marble, nickel, soapstone, and tin. Potash is produced from kelp.

A recent development is the shipping of pebbles for grinding mills.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Brick and tile		$21,423
Copper	159,349 lbs.	43,502
Potash	5,252 tons	1,492,123
Salt	4,500 tons	9,750
Stone, miscellaneous		125,855
Other minerals*		21,055
Total value		$1,713,708

*Includes clay-pottery, gems, granite, lithia, mineral water, molybdenum, silica, and silver.

SAN FRANCISCO.

Area: 43 square miles.

Population: 527,000 (estimate by Chamber of Commerce, 1915).

Surprising as it may appear at first glance, San Francisco County is listed among the mineral producing sections of the state, actual production consisting of crushed rock, sand, and gravel. Small quantities of various valuable mineral substances are found here, including cinnabar, gypsum, lignite, and magnesite, none, however, in paying quantities.

In forty-sixth place, commercial production for 1917 was as follows:

Substance	Amount	Value
Stone, miscellaneous		$107,957

SAN JOAQUIN.

Area: 1,448 square miles.

Population: 70,000 (estimate by Chamber of Commerce, 1914).

Location: Central portion of state.

San Joaquin County reported a mineral production for the year 1917 having a total value of $470,220, as compared with the 1916 output, worth $468,862, the increase being due mainly to manganese. Comparatively few mineral substances are found here, the chief ones being brick, clay, infusorial earth, manganese, natural gas, glass-sand, and miscellaneous stone.

In thirty-first place, commercial production for 1917 was as follows:

Substance	Amount	Value
Brick and tile		$185,060
Manganese	6,320 tons	157,500
Natural gas	348,146 M. cu. ft.	72,585
Stone, miscellaneous		55,003
Other minerals		72
Total value		$470,220

SAN LUIS OBISPO.

Area: 3,334 square miles.

Population: 25,000 (estimate by Chamber of Commerce, 1914).

Location: Bordered by Kern County on the east and the Pacific Ocean on the west.

The total value of the mineral production of San Luis Obispo County in 1917 was $338,144, as compared with the 1916 output, worth $245,807, the increase being due to chromite and quicksilver. Among its mineral resources, both developed and undeveloped, are: Asphalt, bituminous rock, brick, chromite, coal, copper, gypsum, infusorial earth, iron, limestone, marble, mineral water, onyx, petroleum, quicksilver, and miscellaneous stone.

In thirty-fifth place, commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	4,109 tons	$92,846
Mineral water	1,500 gals.	300
Petroleum	74,143 bbls.	68,656
Quicksilver	1,565 flasks	151,034
Stone, miscellaneous		8,422
Other minerals*		16,886
Total value		$338,144

*Includes bituminous rock, brick, manganese, and soda.

SAN MATEO.

Area: 447 square miles.

Population: 35,000 (estimate by Chamber of Commerce, 1914).

Location: Peninsula, adjoined by San Francisco on the north.

San Mateo's most important mineral products are stone, brick, and salt, the last-named being derived by evaporation from the waters of San Francisco Bay. The total value of all mineral production during 1917 equaled $207,162, as compared with the 1916 figures of $135,408, the increase being due to salines.

Small amounts of barytes, chromite, infusorial earth and quicksilver have been noted in addition to the items of economic value given below.

In forty-first place, commercial production for 1917 was as follows:

Substance	Amount	Value
Gems		$150
Salt	36,483 tons	114,689
Stone, miscellaneous		71,668
Other minerals*		20,656
Total value		$207,163

*Includes brick and tile, magnesium chloride and potash.

SANTA BARBARA.

Area: 2,740 square miles.

Population: 32,750 (estimate by Chamber of Commerce, 1914).

Location: Southwestern portion of state, joining San Luis Obispo on the south.

Santa Barbara County owes its position as eighth in the state in regard to its mineral output to the presence of productive oil fields within its boundaries. The total value of its mineral production during the year 1917 was $5,153,081, as compared with the 1916 output of $4,535,029. Santa Barbara, in company with the other oil counties, showed an increase in petroleum valuation for 1917.

Aside from the mineral substances listed below, Santa Barbara County contains asphalt, diatomaceous earth, gilsonite, gypsum, magnesite, and quicksilver in more or less abundance.

Commercial production for 1916 was as follows:

Substance	Amount	Value
Mineral water	104,991 gals.	$86,026
Natural gas	3,104,170 M cu. ft.	227,507
Petroleum	5,631,563 bbls.	4,550,303
Potash	974 tons	126,830
Sandstone	28,700 cu. ft.	6,150
Stone, miscellaneous		5,950
Other minerals*		150,315
Total value		$5,153,081

*Includes brick, diatomaceous earth, limestone, and quicksilver.

SANTA CLARA.

Area: 1,328 square miles.
Population: 90,000 (estimate by board of supervisors, 1914).
Location: West-central portion of state.

Santa Clara County reported a mineral output for 1917 of $991,530 as compared with the 1916 figures of $851,948, the increase being due to a larger yield of quicksilver, more than offsetting the loss in magnesite output on account of the mines on Red Mountain being shut down by litigation for most of the year.

This county, lying largely on the Coast Range Mountains, contains a wide variety of mineral substances, including brick, chromite, clay, limestone, magnesite, manganese, mineral water, petroleum, quicksilver, soapstone, and miscellaneous stone. It stood second in quicksilver yield for the year.

In twenty-seventh place, commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	334 tons	$8,515
Brick		80,000
Clay (pottery)	6,014 tons	4,929
Magnesite	9,963 tons	99,287
Manganese	760 tons	18,606
Mineral water	10,230 gals.	1,923
Petroleum	18,855 bbls.	26,152
Quicksilver	5,921 flasks	639,594
Stone, miscellaneous		111,304
Other minerals*		1,220
Total value		$991,530

*Includes tile and limestone.

SANTA CRUZ.

Area: 435 square miles.
Population: 30,140 (estimate by Chamber of Commerce, 1914).
Location: Bordering Pacific Ocean, just south of San Mateo County.

The mineral output of Santa Cruz County, a portion of which is itemized below, amounted to a total value of $1,668,324, giving the county a standing of seventeenth among all others in the state in this regard.

Among the mineral resources known here are bituminous rock, cement, coal, gold, lime, limestone, petroleum, and miscellaneous stone.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Lime and limestone		$185,156
Stone, miscellaneous		2,368
Other minerals*		1,480,800
Total value		$1,668,324

*Includes bituminous rock, cement, and potash.

SHASTA.

Area: 3,858 square miles.

Population: 19,000 (estimate by County Clerk, 1914).

Location: North-central portion of state.

Shasta County stands fourth in California among the mineral-producing counties for 1917 with an output valued at $10,244,869, as compared with the 1916 production, worth $13,639,508, the decrease being due mainly to the falling off in copper output. Not taking petroleum into account, Shasta leads all the counties by a wide margin. This county is first in copper production, second in silver, first in pyrite, first in zinc, and seventh in gold. The Shasta copper belt contains the most important deposits of this metal yet developed on the Pacific Coast.

Shasta's mineral resources include: Asbestos, barytes, brick, chromite, coal, copper, gold, iron, lead, lime, limestone, mineral water, molybdenum, pyrite, silver, miscellaneous stone, and zinc.

Lassen Peak is located in southeastern Shasta County.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	3,116 tons	$68,479
Copper	28,009,990 lbs.	7,646,727
Gold		775,125
Lead	8,725 lbs.	750
Lime and limestone		78,101
Platinum	14 ounces	1,100
Silver		520,703
Stone, miscellaneous		800
Zinc	8,281,516 lbs.	844,715
Other minerals*		308,369
Total value		$10,244,869

*Includes cadmium, brick, iron ore, mineral water, molybdenum, pyrite, and silica.

SIERRA.

Area: 923 square miles.

Population: 4,098 (1910 census).

Location: Eastern border of state, just north of Nevada County.

Sierra County reported a mineral production of $389,615, consisting mainly of gold and silver, during the year 1917, as compared with the 1916 output, worth $729,497, the decrease being due to the falling off in gold output. Considering gold output alone, this county stands eleventh; and as to total mineral yield, thirty-third.

Aside from the metals itemized below, Sierra County contains deposits of asbestos, chromite, iron, lead, platinum minerals, serpentine, and talc.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Copper	13,031 lbs.	$3,558
Gold		384,428
Silver		1,629
Total value		$389,615

SISKIYOU.

Area: 6,256 square miles.

Population: 25,000 (estimate by County Clerk, 1914).

Location: Extreme north-central portion of state, next to Oregon boundary.

Siskiyou, fifth county in California in regard to size, located in a highly mineralized and mountainous country, ranks thirty-ninth in regard to the value of its mineral output for 1917. Although the county is traversed by a transcontinental railroad in a north and south line, the mineral-bearing sections are almost without exception far from transportation and other facilities. A large part of the county is accessible by trail alone. Future development and exploitation will doubtless increase the productiveness of this part of the state to a great degree.

Among Siskiyou's mineral resources are: Chromite, clay, coal, copper, gems, gold, lead, limestone, manganese, marble, mineral water, pumice, quicksilver, sandstone, silver, and miscellaneous stone.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	2,046 tons	$49,797
Copper	888,043 lbs.	242,436
Gold		325,550
Granite		500
Lead	192 lbs.	17
Mineral water	503,000 gals.	50,600
Platinum	15 ounces	709
Silver		16,883
Stone, miscellaneous		134,382
Other minerals*		8,535
Total value		$829,409

*Includes lime, sandstone, and soda.

SOLANO.

Area: 822 square miles.

Population: 31,000 (estimate by Chamber of Commerce, 1914).

Location: Touching San Francisco Bay on the northeast.

Solano, while mostly valley land, produced mineral substances during the year 1917 to the total value of $1,892,231, ranking fifteenth among the counties of the state, the advance over 1916 being due to cement. Among her mineral resources are: Brick, cement, clay, fuller's earth, limestone, mineral water, natural gas, onyx, petroleum, quicksilver, salt, and miscellaneous stone.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Mineral water	10,960 gals.	$2,580
Quicksilver	554 flasks	52,765
Stone, miscellaneous		39,826
Other minerals*		1,804,060
Total value		$1,899,231

*Includes cement, fuller's earth, natural gas and salt.

SONOMA.

Area: 1,577 square miles.

Population: 48,394 (1910 census).

Location: South of Mendocino County, bordering on the Pacific Ocean.

Sonoma ranked thirty-first among the counties of California during the year 1917, with a mineral production of $506,750, as compared with its 1916 output worth $472,048, the increase being due mainly to quick-

silver. More paving blocks are turned out here than in any other section of the state.

Among Sonoma's mineral resources are: Brick, chromite, clay, copper, graphite, infusorial earth, magnesite, manganese, marble, mineral paint, mineral water, quicksilver, and miscellaneous stone.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	226 tons	$6,200
Magnesite	5,636 tons	61,335
Manganese	362 tons	12,689
Mineral water	121,290 gals.	35,031
Quicksilver	2,592 flasks	244,810
Stone, miscellaneous		146,621
Other minerals		64
Total value		$506,750

STANISLAUS.

Area: 1,450 square miles.

Population: 30,000 (estimate by Board of Trade, 1914).

Location: Center of state, bounded on south by Merced County.

Gold is the chief mineral product of Stanislaus County, although brick, clay, gypsum, iron, manganese, mineral paint, quicksilver, and silver are found here to some extent as well. This county, for 1917, ranks thirty-seventh in the state in regard to value of minerals, with an output of $289,922, as compared with $253,022, the increase being due to chromite, magnesite and manganese. In order not to reveal individual business, the gold, platinum, and silver yields of its single dredge are combined with the data of other minerals.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	1,438 tons	$29,240
Magnesite	3,196 tons	44,350
Manganese	775 tons	26,925
Stone, miscellaneous		6,240
Other minerals*		183,167
Total value		$289,922

*Includes gold, mineral paint, platinum, and silver.

SUTTER.

Area: 608 square miles.

Population: 9,375 (estimate by County Clerk, 1914).

Location: Bounded by Butte County on the north and Sacramento on the south.

Sutter is one of only two counties in the state which for a number of years reported no commercial output of some kind of mineral substance. In 1917 some crushed rock was taken out, from the Marysville Buttes, as indicated below, its relative rank among the counties being fifty-fourth. Both clay and coal exist here, but deposits of neither mineral have been placed on a productive basis.

Substance	Amount	Value
Stone, miscellaneous		$5,000

TEHAMA.

Area: 2,893 square miles.

Population: 14,575 (estimate by County Clerk, 1914).

Location: North-central portion of the state, bounded on the north by Shasta.

Tehama stands fifty-first among the fifty-seven mineral-producing counties of the state. Its mineral output during 1917 was valued at $44,019, as compared with the 1916 production, worth $54,353.

Among its mineral resources are listed: Brick, chromite, copper, gold, manganese, marble, mineral water, salt, and miscellaneous stone.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	2,053 tons	$41,646
Stone, miscellaneous		2,373
Total value		$44,019

TRINITY.

Area: 3,166 square miles.

Population: 3,301 (1910 census).

Location: Northwestern portion of state.

Trinity, like Siskiyou County, requires transportation facilities to further the development of its many and varied mineral resources. Deposits of asbestos, barytes, chromite, copper, gold, mineral water, platinum, quicksilver, silver, and building stone are known here, but with the exception of gold and copper, very little active production of

these mineral substances is possible, as yet. The 1917 output of $987,842 shows an increase over the 1916 figure of $846,561, due mainly to gold, as Trinity was one of the few counties in California not showing a decrease in gold yield for 1917.

In twenty-eighth place, commercial output for 1917 was:

Substance	Amount	Value
Chromite	242 tons	$6,325
Gold		602,048
Platinum	50 ounces	3,283
Silver		10,021
Stone, miscellaneous		7,718
Other minerals*		358,447
Total value		$987,842

*Includes copper, manganese, mineral water, quicksilver.

TULARE.

Area: 4,856 square miles.

Population: 35,440 (1910 census).

Location: Bounded by Inyo on the east, Kern on the south, Fresno on the north.

Tulare stands nineteenth on the list of mineral-producing counties. Her mineral resources, among others, are: Brick, clay, copper, feldspar, graphite, gems, limestone, magnesite, marble, quartz, glass-sand, soapstone, miscellaneous stone, and zinc. Tulare leads the state in magnesite output, and to this is due her advance of practically a half million dollars in 1917 over the 1916 figure.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	450 tons	$11,000
Brick		112,938
Feldspar	240 tons	1,580
Magnesite	136,562 tons	1,238,853
Stone, miscellaneous		75,594
Other minerals*		60,023
Total value		$1,499,988

*Includes building tile, copper, granite, limestone and talc.

TUOLUMNE.

Area: 2,190 square miles.

Population: 9,979 (1910 census).

Location: East-central portion of state—Mother Lode district.

Tuolumne ranks thirtieth among the counties of the state relative to its total value of mineral output. As a producer of marble its standing is first. The decrease in 1917 to $511,273 from the 1916 figure of $1,004,262 was due to the marked falling off in gold output, amounting to over a half million dollars.

Chromite, clay, copper, gold, lead, limestone, marble, mineral paint, platinum, soapstone, silver, and miscellaneous stone, are among its mineral resources.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Chromite	2,680 tons	$54,290
Copper	32,840 lbs.	8,965
Gold		321,085
Lead	997 lbs.	86
Limestone	3,287 tons	6,481
Silver		7,808
Stone, miscellaneous		3,800
Other minerals*		108,758
Total value		$511,273

*Includes dolomite, lime, magnesite and marble.

VENTURA.

Area: 1,878 square miles.

Population: 21,000 (estimate by Chamber of Commerce, 1914).

Location: Southwestern portion of state, bordering on Pacific Ocean.

Ventura is the twentieth county in the state in respect to the value of its mineral production for 1917, the exact figure being $1,498,010, as compared with the output for 1916, worth $1,135,430.

The highest gravity petroleum produced in the state is found here.

Among its other mineral resources are: Asphalt, borax, brick, clay, mineral water, natural gas, sandstone, and miscellaneous stone.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Natural gas	1,033,564 M cu. ft.	$152,550
Petroleum	996,501 bbls.	1,313,388
Stone, miscellaneous		30,000
Other minerals*		2,072
Total value		$1,498,010

*Includes brick and sandstone.

YOLO.

Area: 1,014 square miles.

Population: 15,000 (estimate by County Clerk, 1914).

Location: Sacramento Valley, bounded by Sutter on the east and Colusa on the north.

The mineral production from Yolo County during the year 1917 consisted mainly of quicksilver and miscellaneous stone, valued at $5,561, ranking it in fifty-third place. Deposits of undetermined value of iron and sandstone have been discovered within the confines of this county.

Commercial production for 1917 was as follows:

Substance	Amount	Value
Stone, miscellaneous		$4,300
Other minerals		1,261
Total value		$5,561

YUBA.

Area: 639 square miles.

Population: 14,750 (estimate by County Clerk, 1914).

Location: Lies west of Sierra and Nevada counties: south of Plumas.

Yuba is eleventh of the fifty-seven mineral-producing counties of the state, and is second in regard to gold output, surpassing Amador County in 1917 in gold yield, which has usually alternated in the lead with Nevada County. Iron deposits have been reported in this county, aside from the following commercial production as reported for the year 1917:

Substance	Amount	Value
Gold		$3,677,673
Platinum	149 ounces	8,869
Silver		6,591
Stone, miscellaneous		28,863
Total value		$3,721,996

CHAPTER EIGHT.

APPENDIX.

MINING BUREAU ACT.

Chapter 679.

[Stats., 1913.]

An act establishing a state mining bureau, creating the office of state mineralogist, fixing his salary and prescribing his powers and duties; providing for the employment of officers and employees of said bureau, making it the duty of persons in charge of mines, mining operations and quarries to make certain reports, providing for the investigation of mining operations, dealings and transactions and the prosecution for defrauding, swindling and cheating therein, creating a state mining bureau fund for the purpose of carrying out the provisions of this act and repealing an act entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, who shall have the direction, management and control of said state mining bureau, and to provide for the appointment, duties, and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, and all acts amendatory thereof and supplemental thereto or in conflict herewith.

[Approved June 16, 1913. In effect August 10, 1913.]

The people of the state of California do enact as follows:

SECTION 1. There is hereby created and established a state mining bureau. The chief officer of such bureau shall be the state mineralogist, which office is hereby created.

SEC. 2. It shall be the duty of the governor of the state of California and he is hereby empowered to appoint a citizen and resident of this state, having a practical and scientific knowledge of mining, to the office of state mineralogist. Said state mineralogist shall hold his office at the pleasure of the governor. He shall be a civil executive officer. He shall take and subscribe the same oath of office as other state officers. He shall receive for his services a salary of three hundred dollars ($300) per month, to be paid at the same time and in the same manner as the salaries of other state officers. He shall also receive his necessary traveling expenses when traveling on the business of his office. He shall give bond for the faithful performance of his duties in the sum of ten thousand dollars ($10,000), said bond to be approved by the governor of the state of California.

SEC. 3. Said state mineralogist shall employ competent geologists, field assistants, qualified specialists and office employees when necessary in the execution of his plans and operations of the bureau, and fix their compensation. The said employees shall be allowed their necessary traveling expenses when traveling on the business of said department and shall hold office at the pleasure of said state mineralogist.

SEC. 4. It shall be the duty of said state mineralogist to make, facilitate, and encourage, special studies of the mineral resources and mineral industries of the state. It shall be his duty: to collect statistics concerning the occurrence and production of the economically important minerals and the methods pursued in making their valuable constituents available for commercial use; to make a collection of typical geological and mineralogical specimens, especially those of economic and commercial importance, such collection constituting the museum of the state mining bureau; to provide a library of books, reports, drawings, bearing upon the mineral industries, and sciences of mineralogy and geology, and arts of mining and metallurgy, such library constituting the library of the state mining bureau; to make a collection of models, drawings and descriptions of the mechanical appliances used in mining and metallurgical processes; to preserve and so maintain such collections

and library as to make them available for reference and examination, and open to public inspection at reasonable hours; to maintain, in effect, a bureau of information concerning the mineral industries of this state, to consist of such collections and library, and to arrange, classify, catalogue, and index the data therein contained, in a manner to make the information available to those desiring it; to issue from time to time such bulletins as he may deem advisable concerning the statistics and technology of the mineral industries of this state.

SEC. 5. It is hereby made the duty of the owner, lessor, lessee, agent, manager or other person in charge of each and every mine, of whatever kind or character, within the state, to forward to the state mineralogist, upon his request, at his office not later than the thirtieth day of June, in each year, a detailed report upon forms which will be furnished showing the character of the mine, the number of men then employed, the method of working such mine and the general condition thereof, the total mineral production for the past year, and such owner, lessor, lessee, agent, manager or other person in charge of any mine within the state must furnish whatever information relative to such mine as the state mineralogist may from time to time require for the proper discharge of his official duties. Any owner, lessor, lessee, agent, manager or other person in charge of each and every mine, of whatever kind or character within the state, who fails to comply with the above provisions shall be deemed guilty of a misdemeanor.*

SEC. 6. The state mineralogist now performing the duties of the office of state mineralogist shall perform the duties of the office of state mineralogist as in this act provided until the appointment and qualification of his successor as in this act provided.

SEC. 7. The said state mineralogist shall take possession, charge and control of the offices now occupied and used by the board of trustees and state mineralogist and the museum, library and laboratory of the mining bureau located in San Francisco as provided for by a certain act of the legislature approved March 23, 1893, and hereafter referred to in section fourteen hereof, and shall maintain such offices, museum, library and laboratory for the purposes provided in this act.

SEC. 8. Said state mineralogist or qualified assistant shall have full power and authority at any time to enter or examine any and all mines, quarries, wells, mills, reduction works, refining works and other mineral properties or working plants in this state in order to gather data to comply with the provisions of this act.

SEC. 9. The state mineralogist shall make a biennial report to the governor on or before the fifteenth day of September next preceding the regular session of the legislature.

SEC 10. All moneys received by the state mining bureau or any officer thereof (except such as may be paid to them by the state for disbursement) shall be receipted for by the state mineralogist or other officer authorized by him to act in his place and at least once a month accounted for by him to the state controller and paid into the state treasury to the credit of a fund which is hereby created and designated "state mining bureau fund." All moneys now in the possession of the state mining bureau or any officer thereof received from any source whatsoever, shall be immediately paid over to the state mineralogist and by him accounted for to the controller and paid into the state treasury to the credit of said fund. Said fund shall be used and is hereby appropriated for the use of said bureau in carrying out the purposes of this act.

SEC. 11. The said state mineralogist is hereby authorized and empowered to receive on behalf of this state, for the use and benefit of the state mining bureau, gifts, bequests, devices and legacies of real or other property and to use the same in accordance with the wishes of the donors, and if no instructions are given by said donors, to manage, use, and dispose of the gifts and bequests and legacies for the best interests of said state mining bureau and in such manner as he may deem proper.

*Sec. 19 of the Penal Code of California provides: "Except in cases where a different punishment is prescribed by this code, every offense declared to be a misdemeanor is punishable by imprisonment in a county jail not exceeding six months, or by a fine not exceeding five hundred dollars, or by both."

SEC. 12. The state mineralogist may, whenever he deems it advisable, prepare a special collection of ores and minerals of California to be sent to or used at any world's fair or exposition in order to display the mineral wealth of the state.

SEC. 13. The state mineralogist is hereby empowered to fix a price upon and to dispose of to the public, at such price, any and all publications of the state mining bureau, including reports, bulletins, maps, registers or other publications, such price shall approximate the cost of publication and distribution. Any and all sums derived from such disposition, or from gifts or bequests made, as hereinbefore provided must be accounted for by said state mineralogist and turned over to the state treasurer to be credited to the mining bureau fund as provided for in section ten. He is also empowered to furnish without cost to public libraries the publications of the bureau, and to exchange publications with other geological surveys and scientific societies, etc.

SEC. 14. The state mineralogist provided for by this act shall be the successor in interest of the board of trustees of the state mining bureau, and the state mineralogist, under and by virtue of that certain act, entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, who shall have the direction, management, and control of said state mining bureau, and to provide for the appointment, duties, and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, and all books, papers, documents, personal property, records, and property of every kind and description obtained or possessed, or held or controlled by the said board of trustees of the said state mining bureau, and the state mineralogist, and the clerks and employees thereof, under the provisions of said act of March 23, 1893, or any act supplemental thereto or amendatory thereof, shall immediately be turned over and delivered to the said state mineralogist herein provided for, who shall have charge and control thereof.

SEC. 15. That certain act entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, and to provide for the appointment, duties and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction, and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, together with all acts amendatory thereof and supplemental thereto and all acts in conflict herewith are hereby repealed.

PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

Publications of this Bureau will be sent on receipt of the requisite amount. Only stamps, coin or money orders will be accepted in payment.

Money orders should be made payable to the STATE MINING BUREAU.

Personal checks will not be accepted.

REPORTS.

Asterisk (*) indicates the publication is out of print.

		Price
*Report I.	Henry G. Hanks. 1880.	
*Report II.	Henry G. Hanks. 1882.	
*Report III.	Henry G. Hanks. 1883.	
*Report IV.	Henry G. Hanks. 1884.	
*Report V.	Henry G. Hanks. 1885.	
*Report VI.	Part 1. Henry G. Hanks. 1886.	
*Report VI.	Part 2. Wm. Irelan, Jr. 1886.	
*Report VII.	Wm. Irelan, Jr. 1887.	
*Report VIII.	Wm. Irelan, Jr. 1888.	
*Report IX.	Wm. Irelan, Jr. 1889.	
*Report X.	Wm. Irelan, Jr. 1890.	
Report XI.	Wm. Irelan, Jr. 1892. (First biennial)	$1.00
*Report XII.	J. J. Crawford. 1894. (Second biennial)	----
*Report XIII.	J. J. Crawford, 1896. (Third biennial)	----
Chapters of State Mineralogist's Report, Biennial period, 1913–1914, Fletcher Hamilton:		
	Mines and Mineral Resources of Imperial and San Diego Counties—F. J. H. Merrill. 1914	.35
	Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties—W. B. Tucker. 1915	.50
	Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties—Walter W. Bradley. 1915	.50
	Mines and Mineral Resources, Del Norte, Humboldt and Mendocino Counties—F. L. Lowell. 1915	.25
	Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties—Walter W. Bradley, G. C. Brown, F. L. Lowell and R. P. McLaughlin. 1915	.50
	Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties—G. C. Brown. 1915	.50
Report XIV.	Fletcher Hamilton, 1915, Biennial period 1913–1914. (The above county chapters combined in a single volume)	2.00
Chapters of State Mineralogist's Report, Biennial Period, 1915–1916, Fletcher Hamilton:		
	Mines and Mineral Resources, Alpine, Inyo and Mono Counties, with geological map—Arthur S. Eakle, Emile Huguenin, R. P. McLaughlin, Clarence A. Waring. 1917	1.25
	Same as above, without geological map	.65
	Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties—W. Burling Tucker, Clarence A. Waring. 1917	.50
	Mines and Mineral Resources, El Dorado, Placer, Sacramento and Yuba Counties—W. Burling Tucker, Clarence A. Waring. 1917	.65
	Mines and Mineral Resources, Los Angeles, Orange and Riverside Counties—Frederick J. H. Merrill. 1917	.50
	Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara and Ventura Counties—Walter W. Bradley, Emile Huguenin, C. A. Logan, Clarence A. Waring. 1917	.65
	Mines and Mineral Resources, San Bernardino and Tulare Counties—H. C. Cloudman, Emile Huguenin, F. J. H. Merrill, W. Burling Tucker. 1917	.65
Report XV.	Fletcher Hamilton, 1918, Biennial period, 1915–1916. (The above county chapters combined in a single volume)	(In press)

BULLETINS.

*Bulletin 1.	Dessicated Human Remains.—Winslow Anderson. 1888	----
*Bulletin 2.	Methods of Mine Timbering.—W. H. Storms. 1894	----
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*Bulletin 12.	Mineral Production of California, by Counties, 1896.—Chas. G. Yale. (Tabulated sheet)	----

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Bulletin 83.	California Mineral Production for 1917, with County Maps.—Walter W. Bradley. 1918	----

Preliminary Reports.

*Preliminary Report No. 1.	Notes on Damage by Water in California Oil Fields, Dec., 1913. By R. P. McLaughlin	----
*Preliminary Report No. 2.	Notes on Damage by Water in California Oil Fields, Mar., 1914. By R. P. McLaughlin	----
*Preliminary Report No. 3.	Manganese and Chromium, 1917. By E. S. Boalich	----
Preliminary Report No. 3.	Manganese and Chromium. By E. S. Boalich. (Second edition)	----
Preliminary Report No. 4.	Tungsten, Molybdenum and Vanadium, 1918. By E. S. Boalich and W. O. Castello	----
Preliminary Report No. 5.	Antimony, Graphite, Nickel, Potash, Strontium, Tin, 1918. By E. S. Boalich and W. O. Castello	----

Registers of Mines with Maps.

Amador County	$.25
Butte County	.25
*Calaveras County	----
*El Dorado County	----
*Inyo County	----
*Kern County	----
Lake County	.25
Mariposa County	.25
*Nevada County	----
*Placer County	----
*Plumas County	----
*San Bernardino County	----
*San Diego County	----
Santa Barbara County	.25
*Shasta County	----
*Sierra County	----
*Siskiyou County	----
*Trinity County	----
*Tuolumne County	----
Yuba County	.25
Register of Oil Wells (with map), Los Angeles City	.35

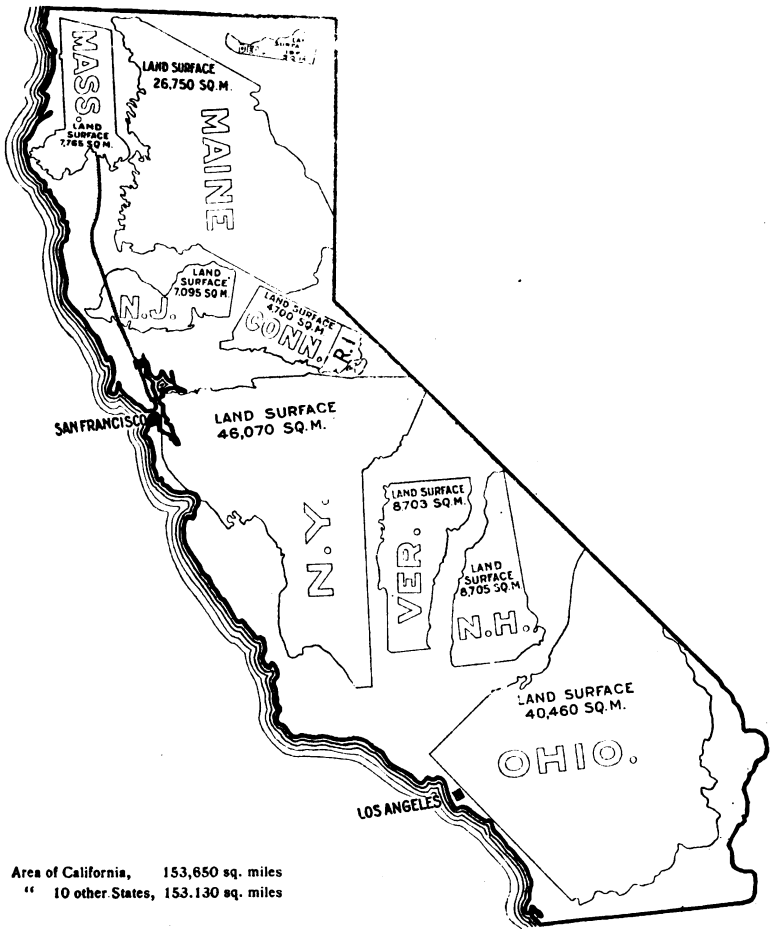
‡Write for price-list.

OTHER MAPS.

	Price
*California, Showing Mineral Deposits (50x60 in.)—	
Mounted	$1.50
Forest Reserves in California—	
Mounted	.50
Unmounted	.30
*Mineral and Relief Map of California	----
El Dorado County, Showing Boundaries of National Forests	.20
Madera County, Showing Boundaries of National Forests	.20
Placer County, Showing Boundaries of National Forests	.20
Shasta County, Showing Boundaries of National Forests	.20
Sierra County, Showing Boundaries of National Forests	.20
Siskiyou County, Showing Boundaries of National Forests	.20
Trinity County, Showing Boundaries of National Forests	.45
Tuolumne County, Showing Boundaries of National Forests	.20
*Mother Lode Region	----
Desert Region of Southern California	.10
Minaret Region, Madera County	.20
Copper Deposits in California	.05
Calaveras County	.25
Plumas County	.25
Tuolumne County	.25
Geological Map of California (mounted)—50x60 inches	2.50

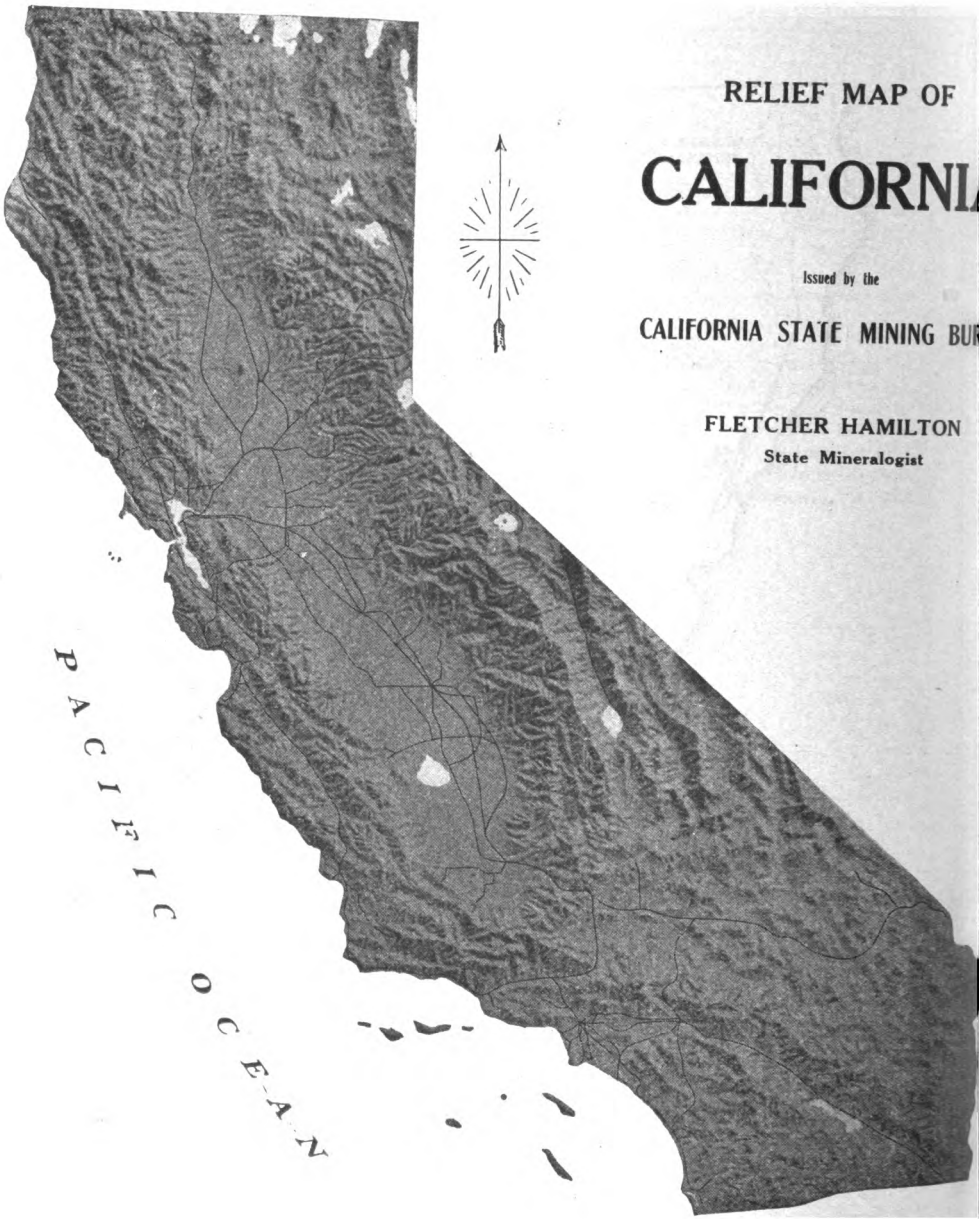
DETERMINATION OF MINERAL SAMPLES.

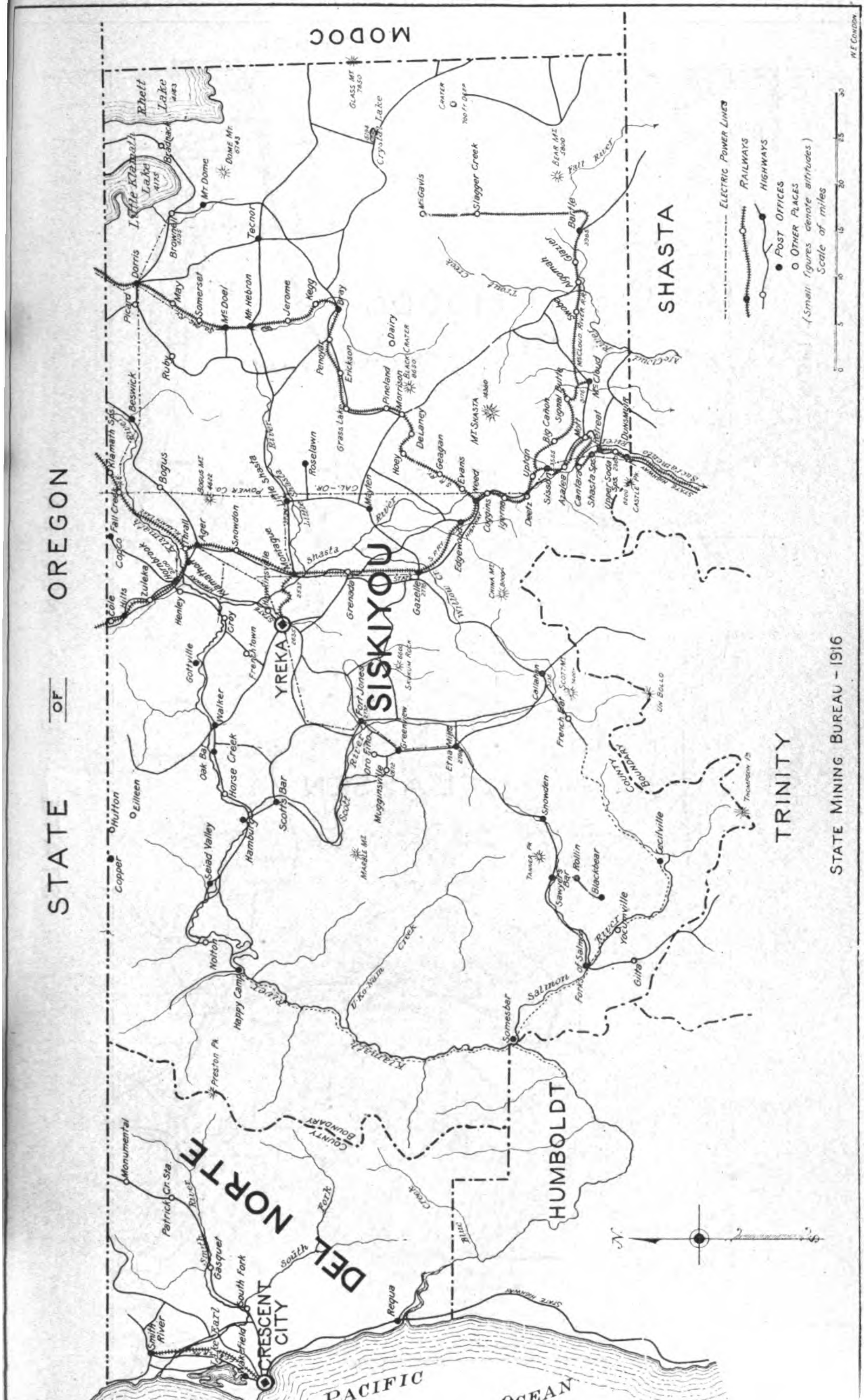
Samples (limited to three at one time) of any mineral found in the state may be sent to the Bureau for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

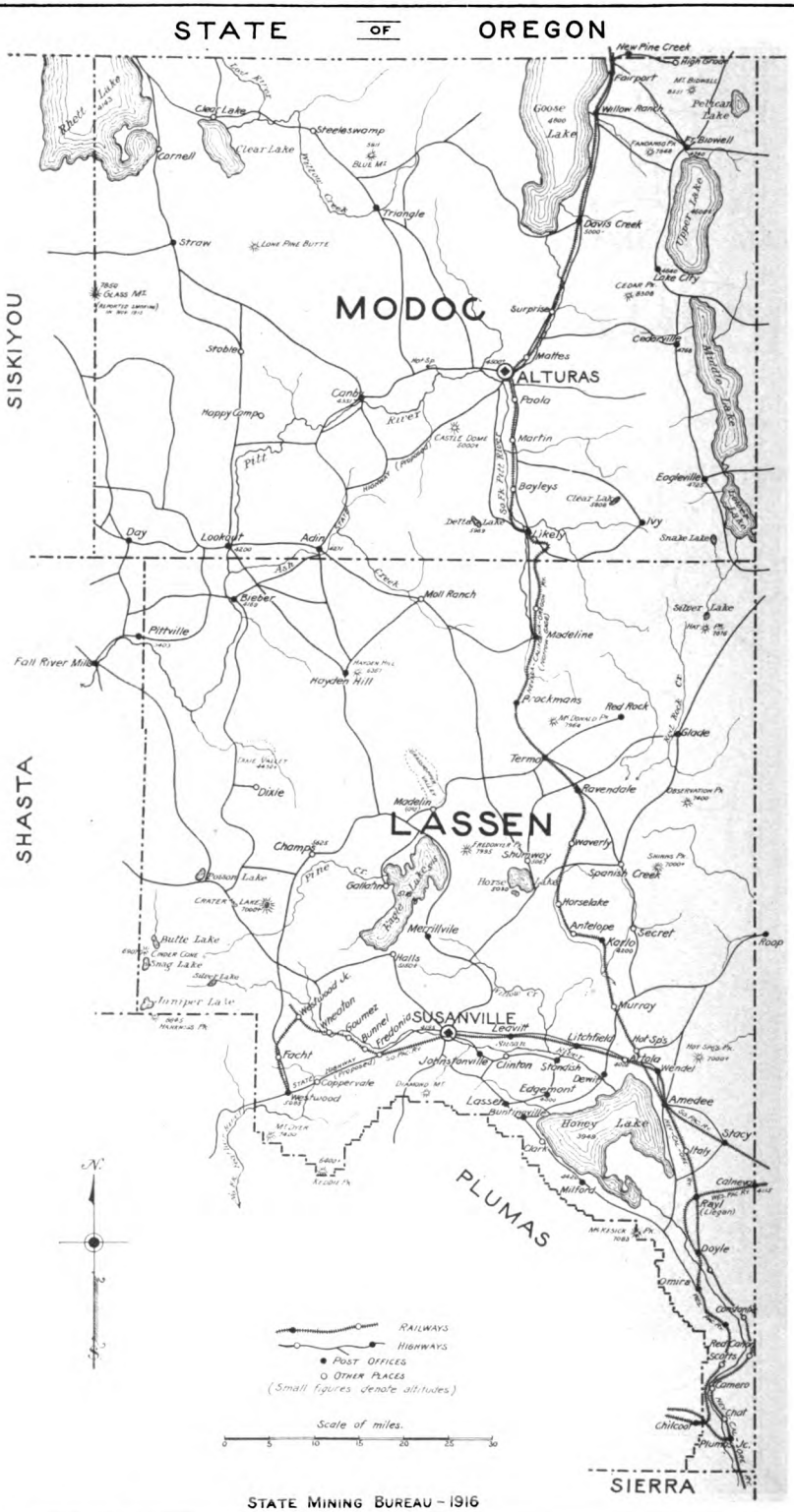


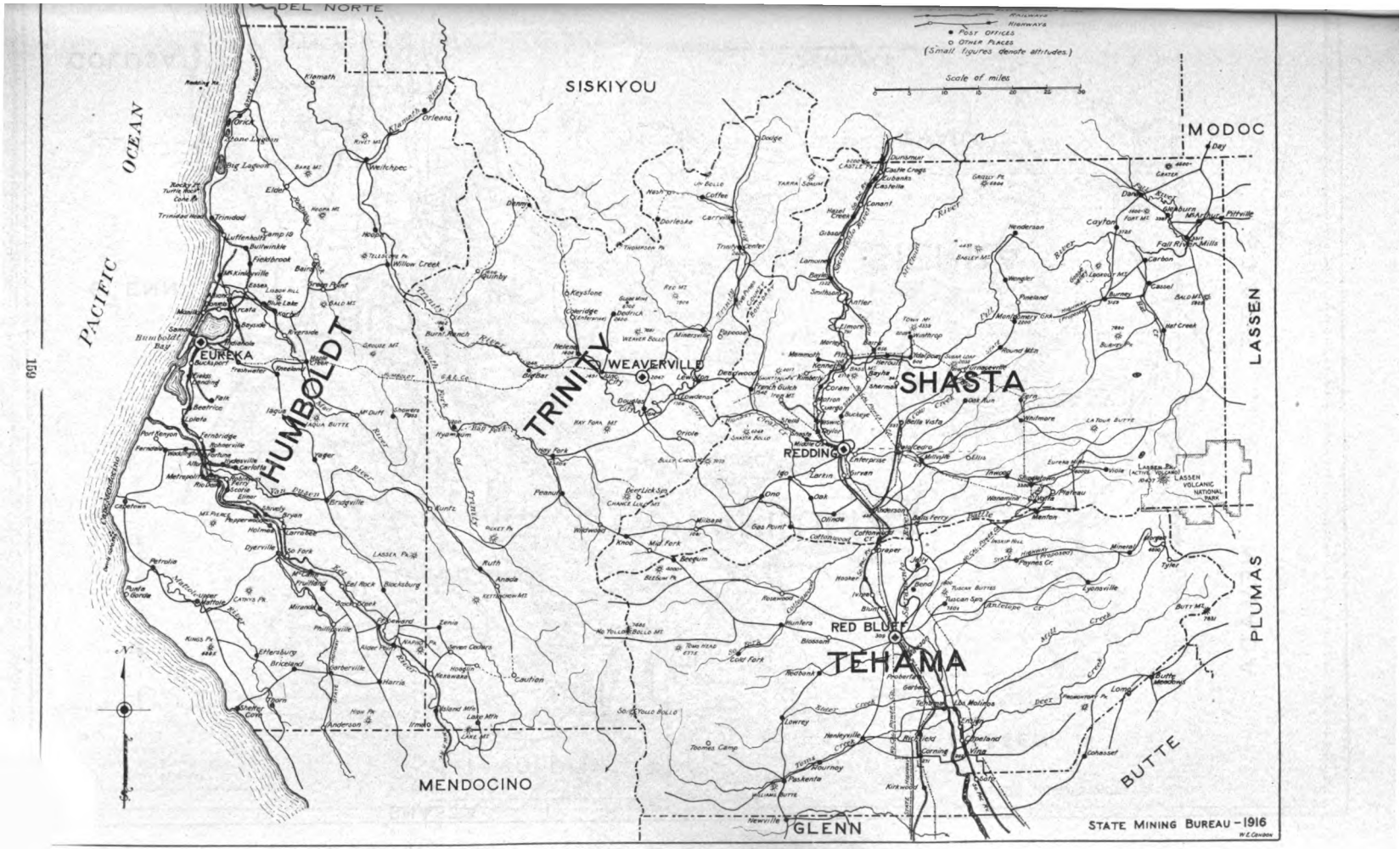
Outline map of California, showing relative areas of ten other states.

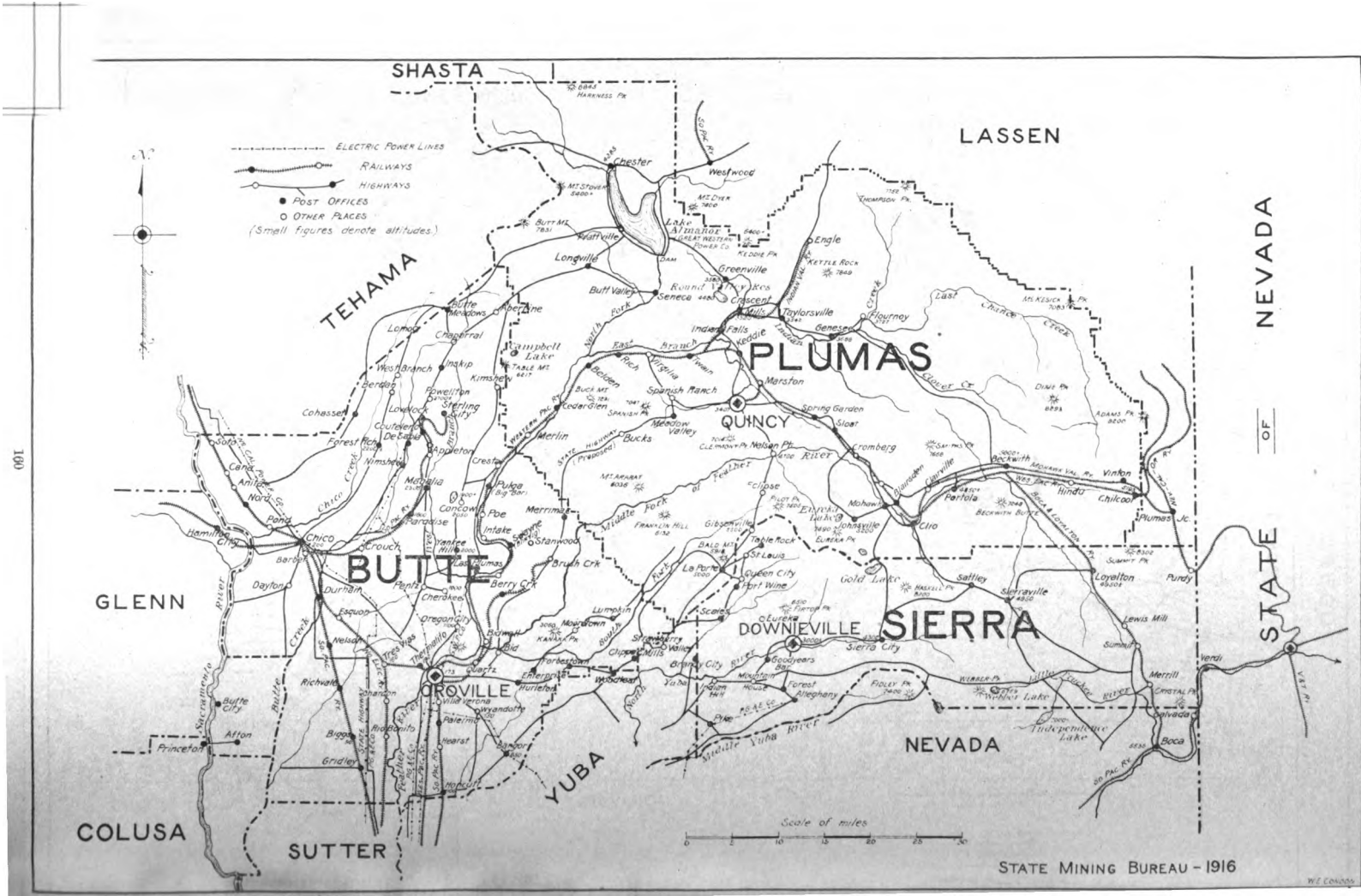
The following county maps show all towns, post offices, railroads, stage lines, and the highways. They are especially valuable to all who wish to leave the railroad and penetrate to the interior of the mining districts of the state. These maps must not be reproduced without obtaining permission from the Mining Bureau.

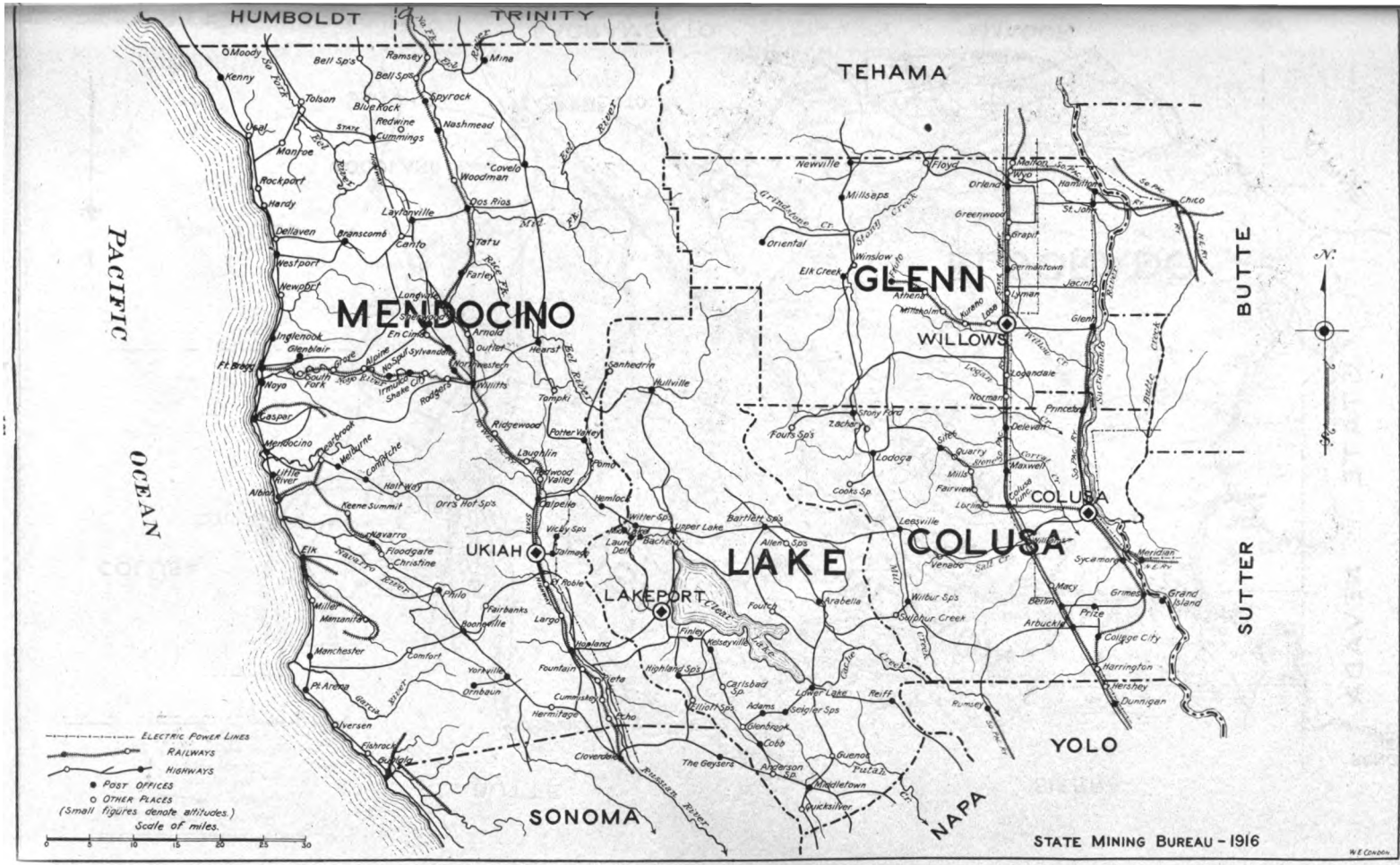


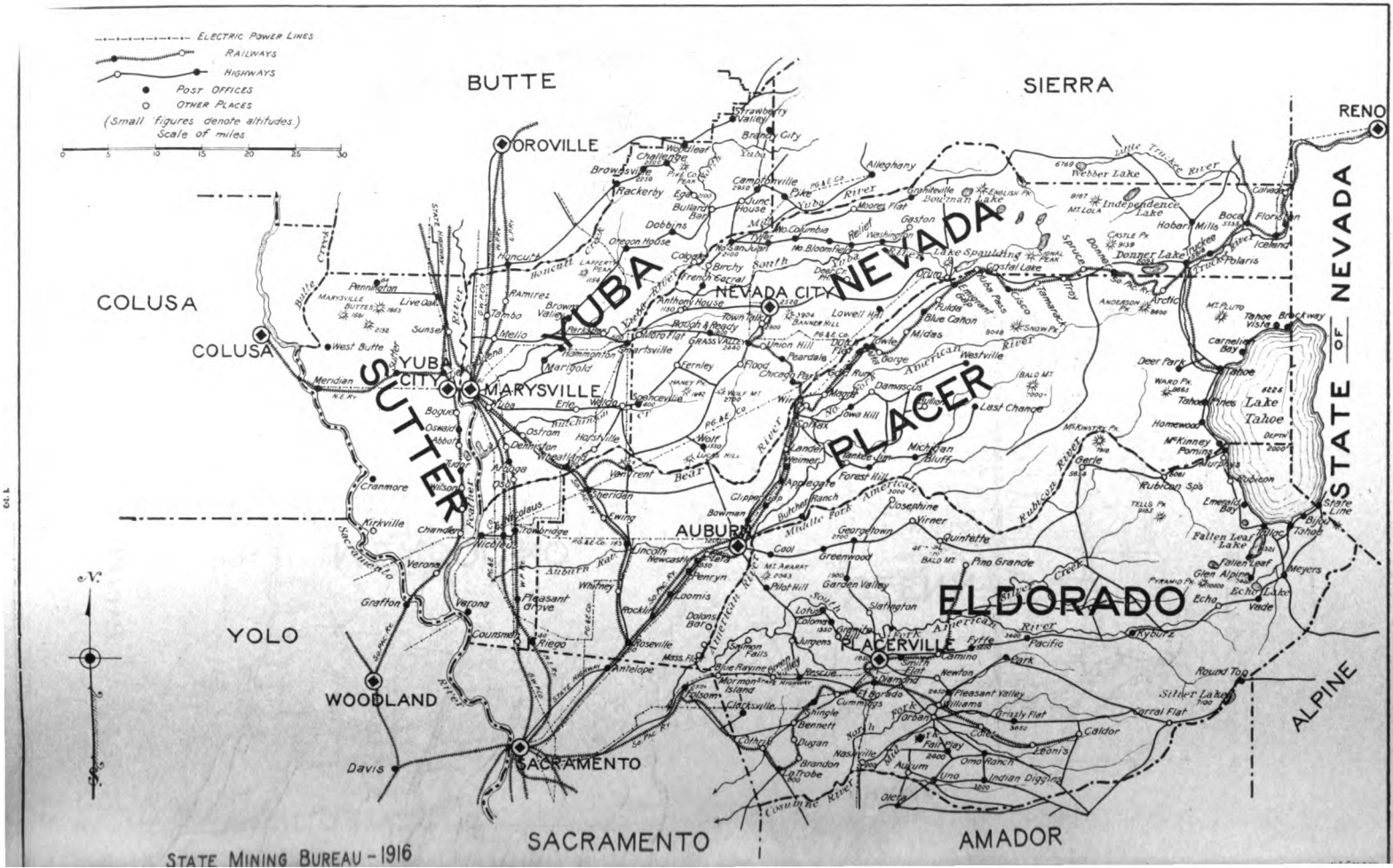


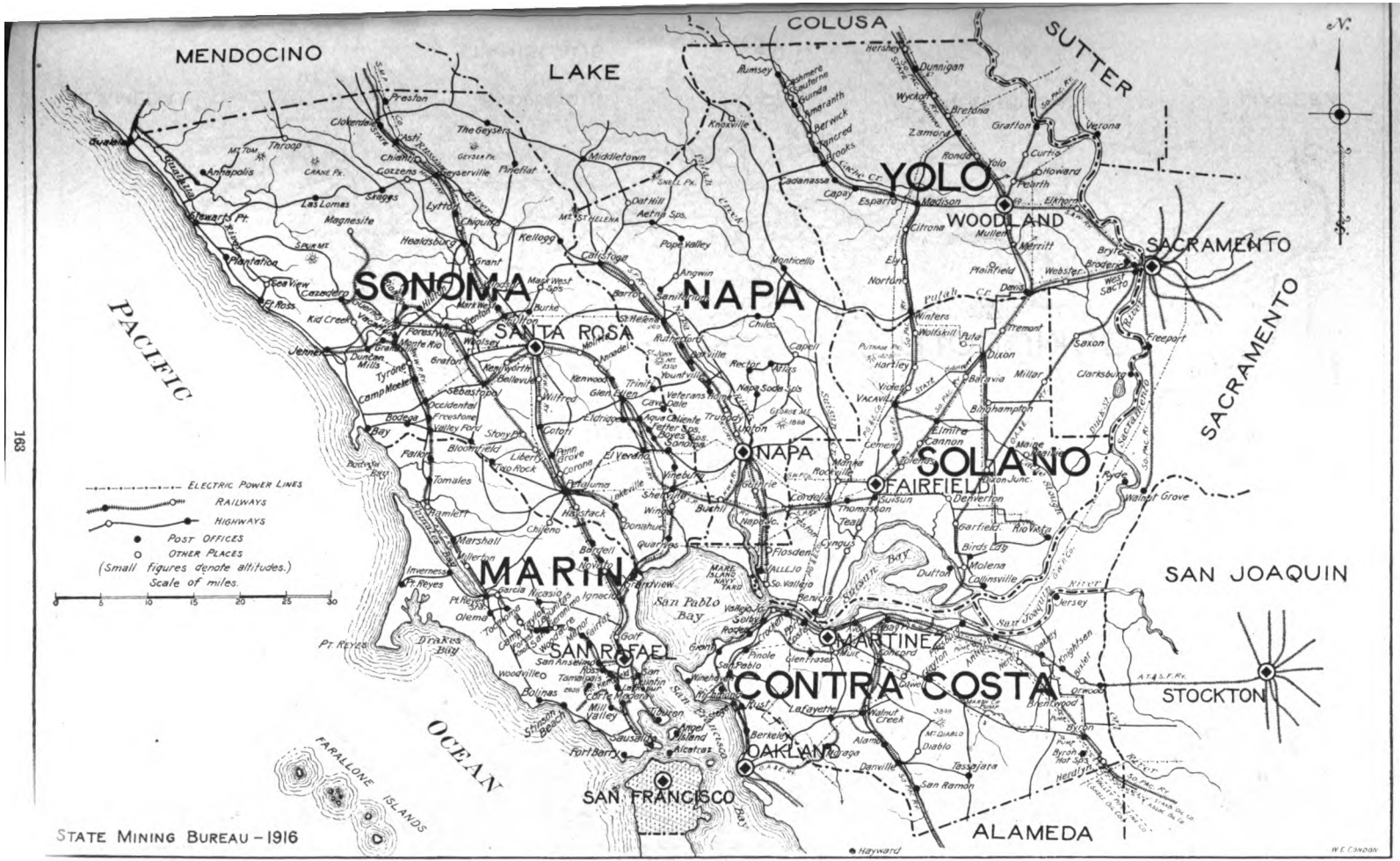


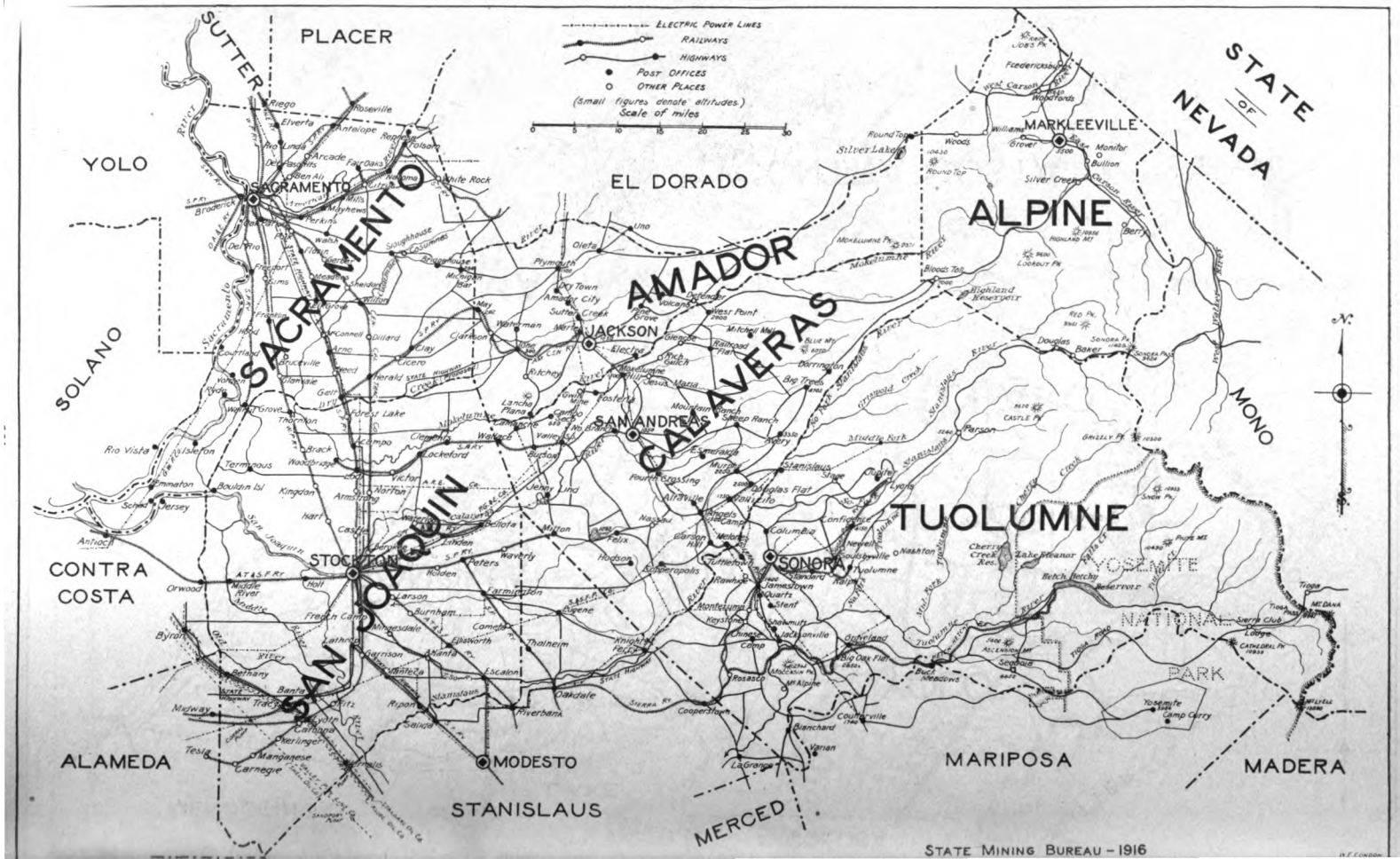


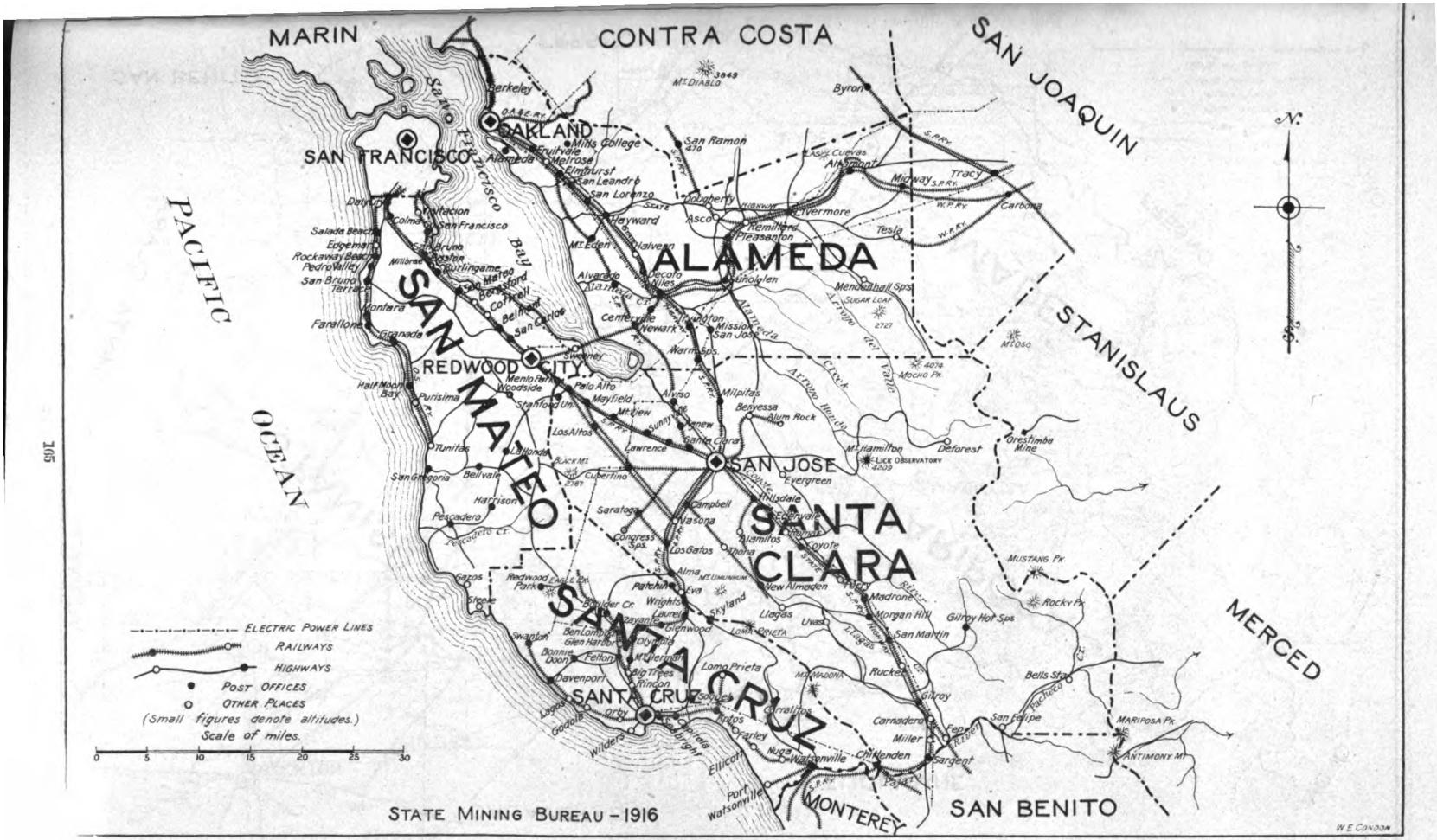


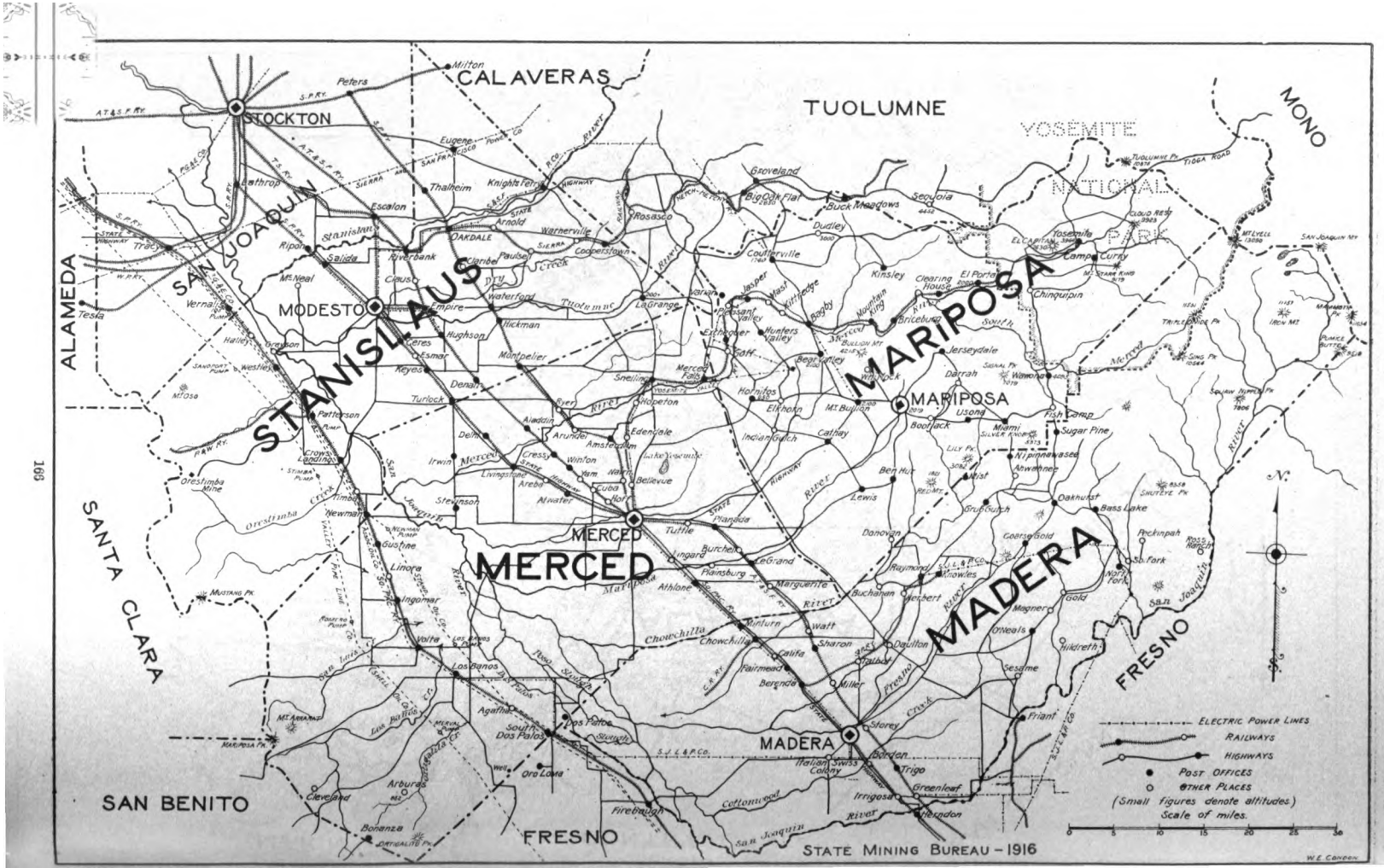


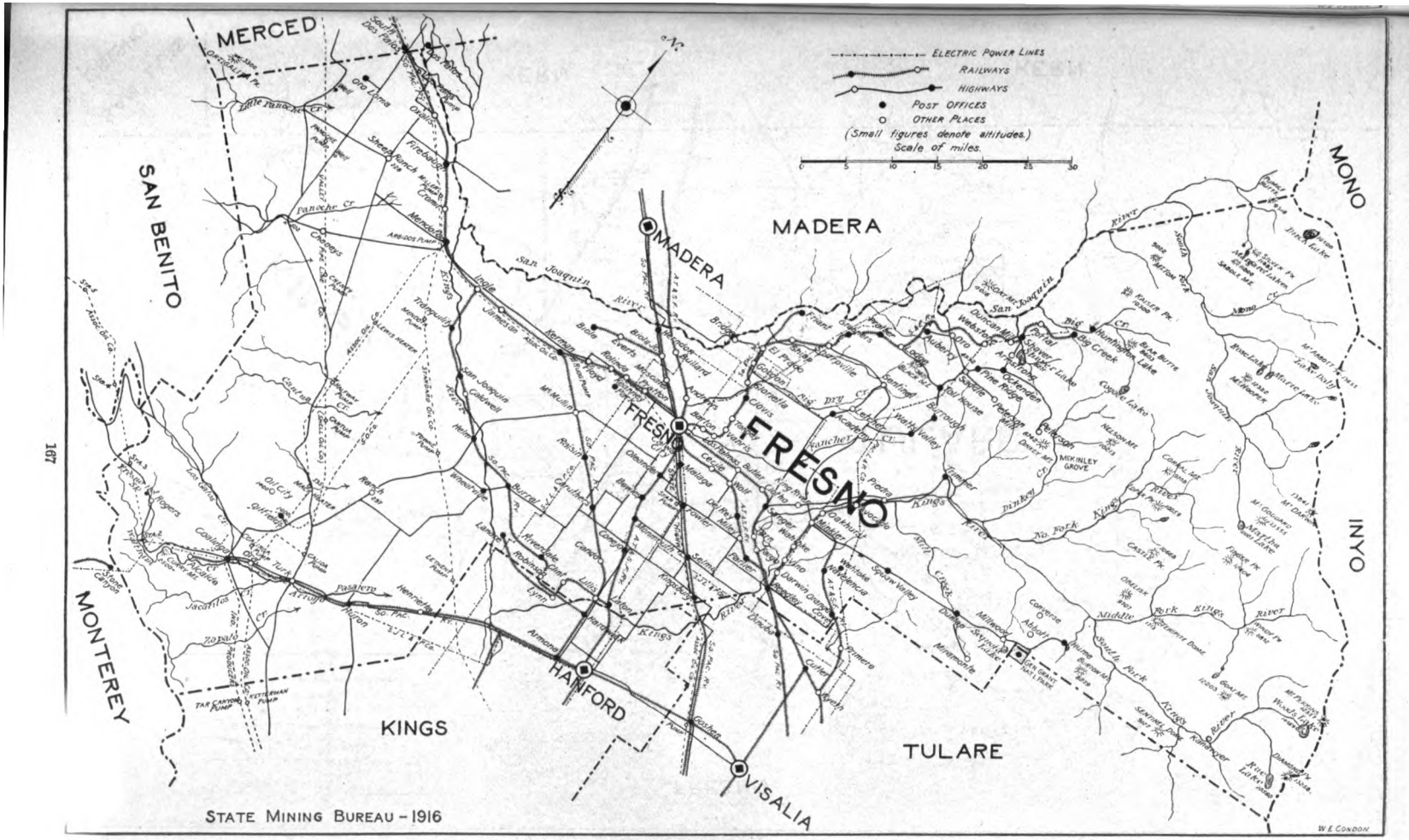


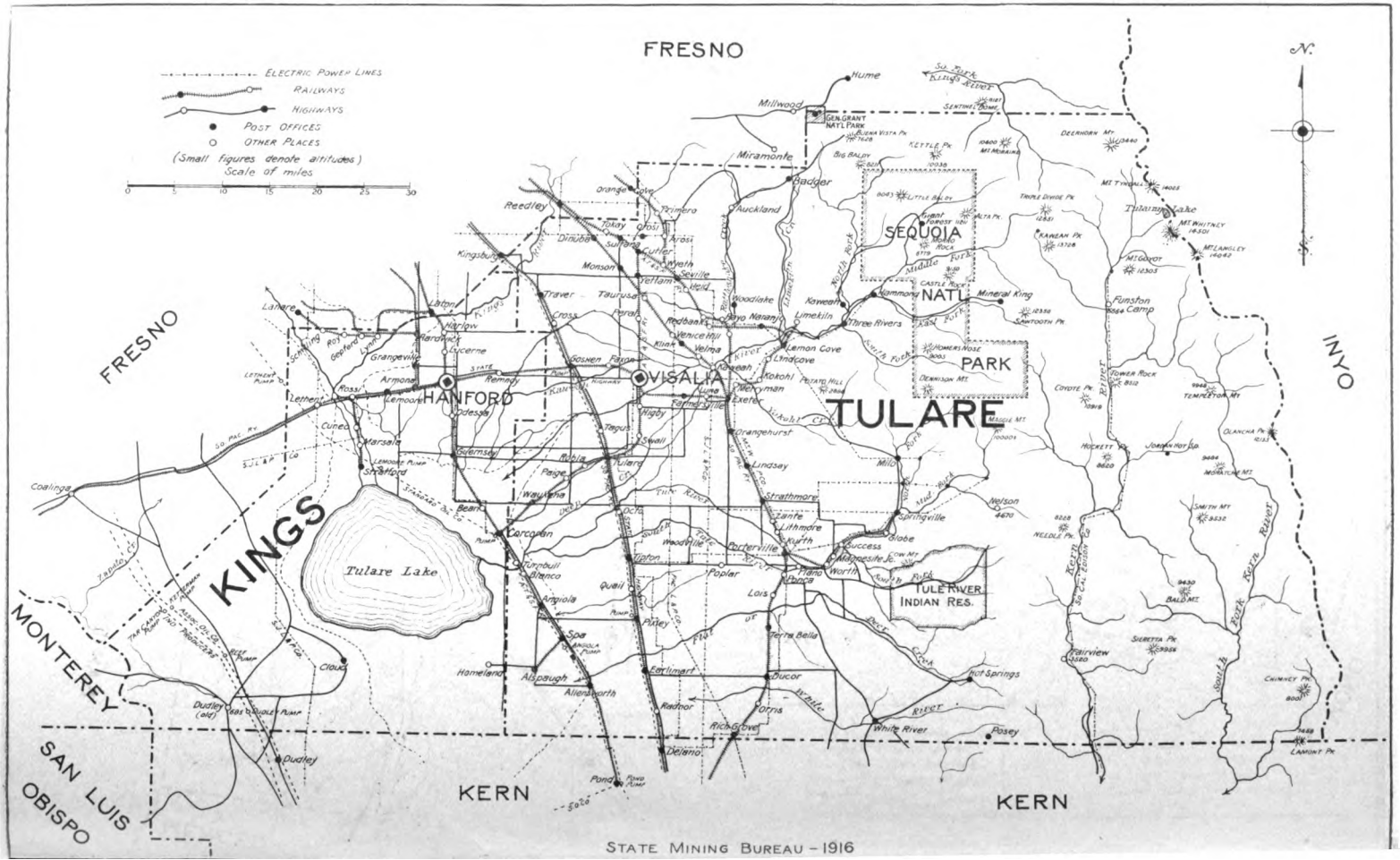












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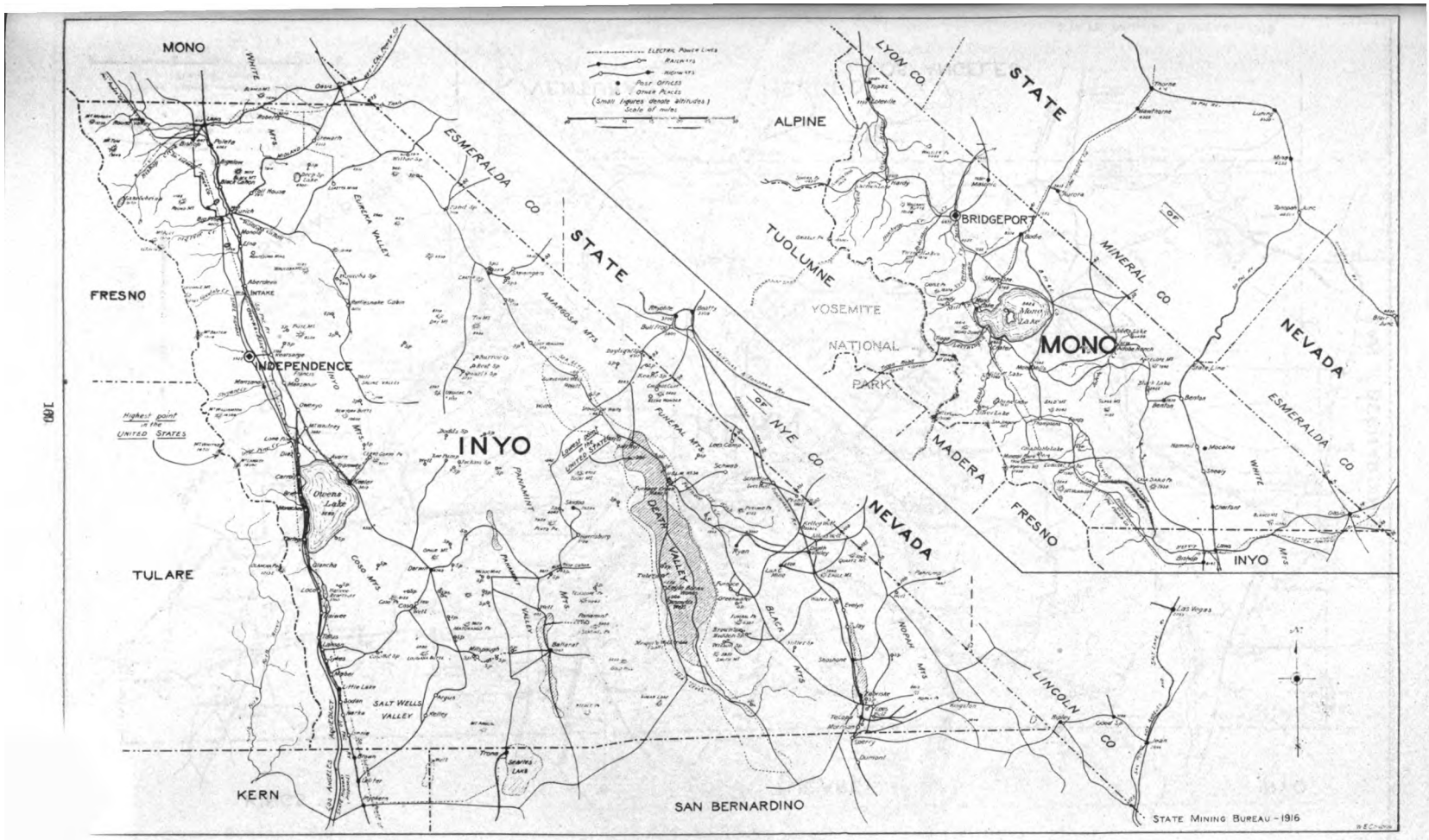

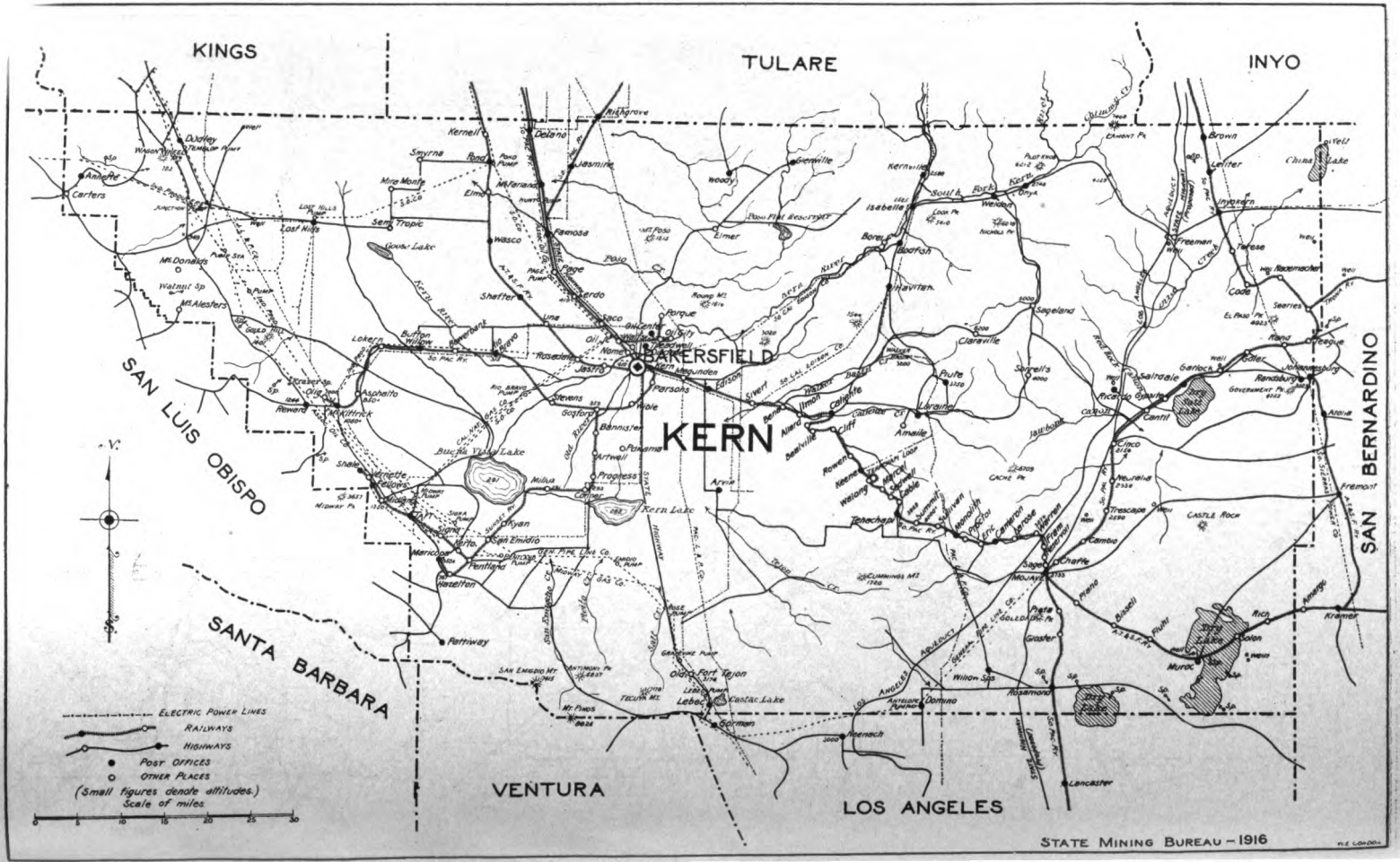

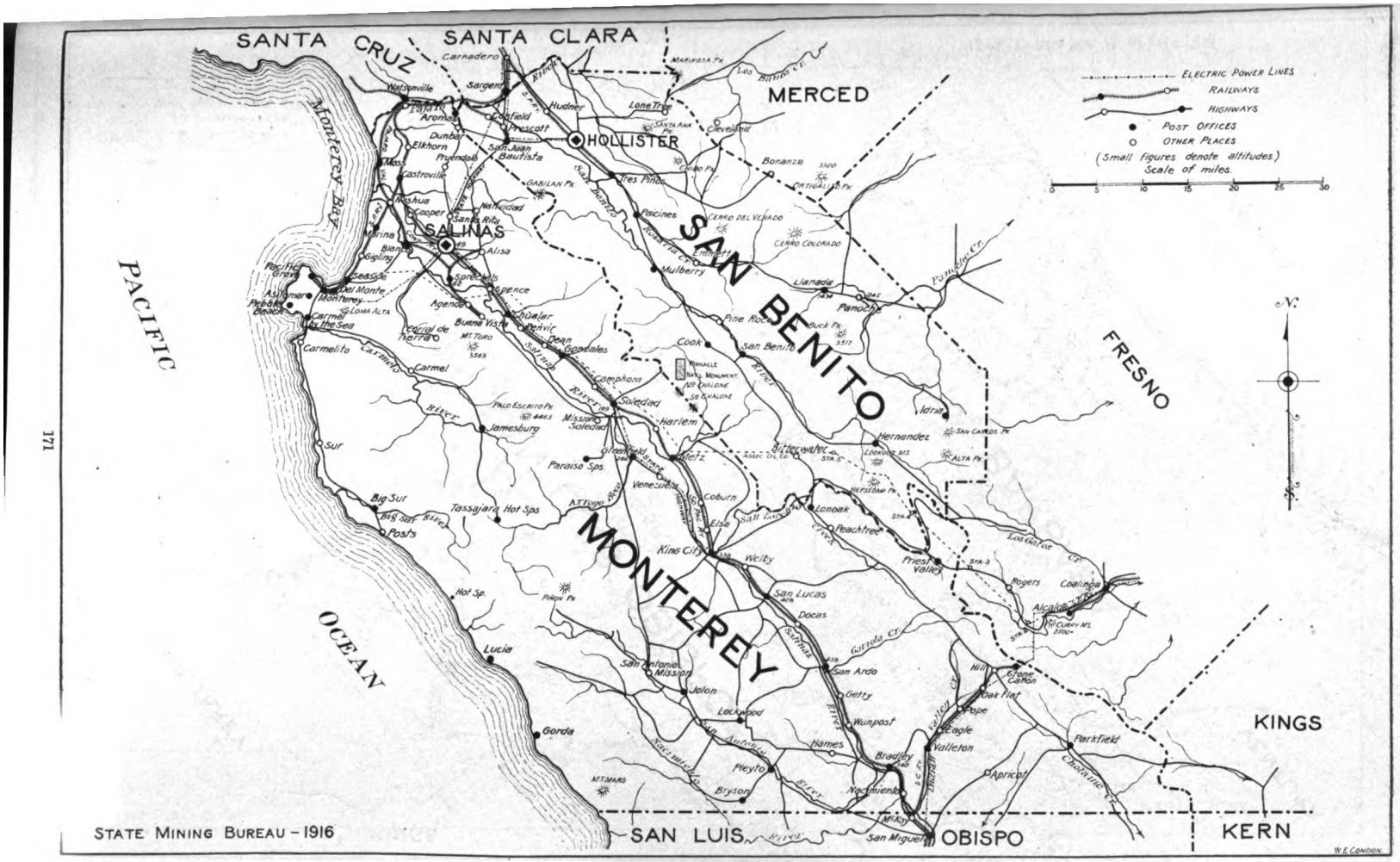

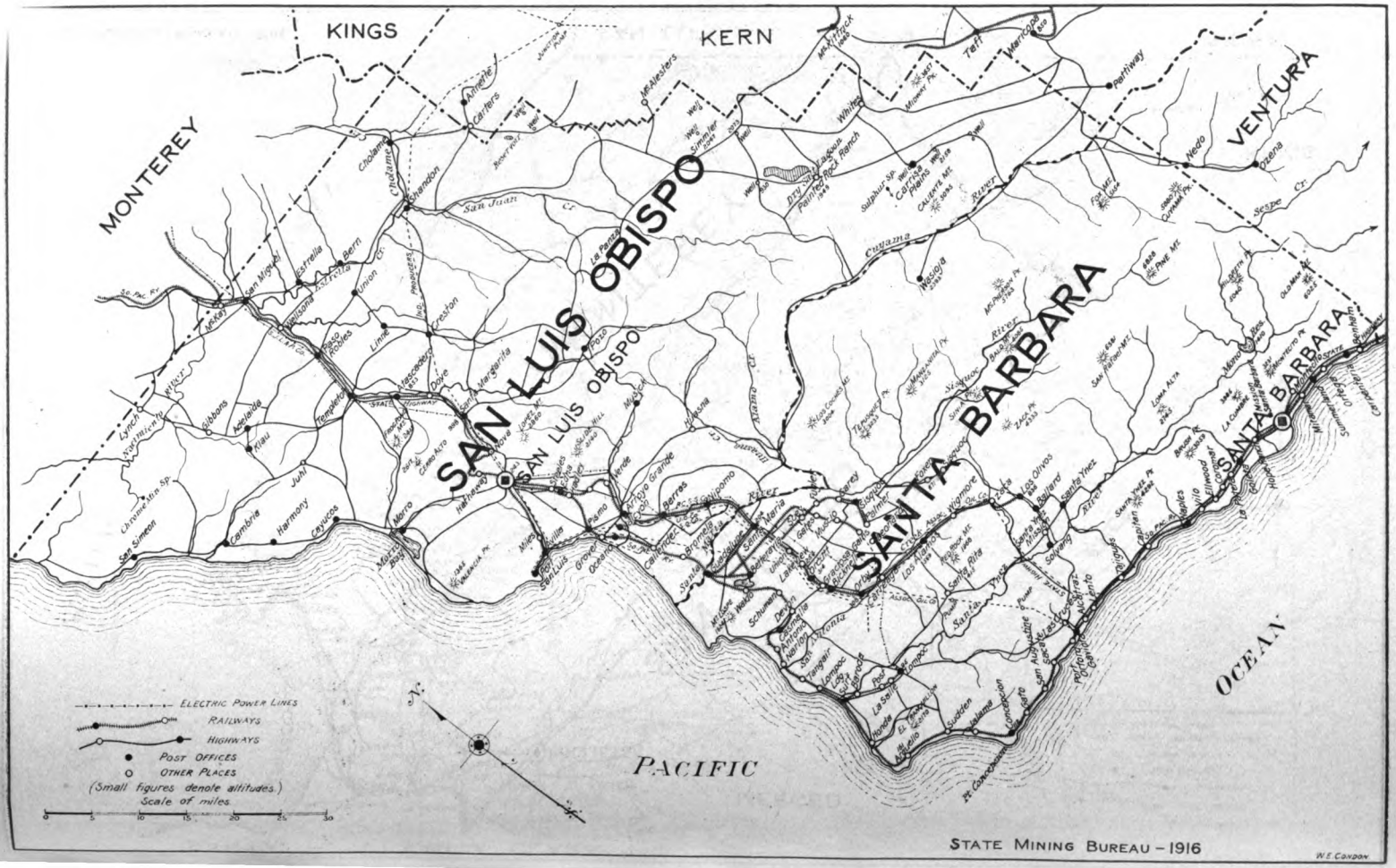

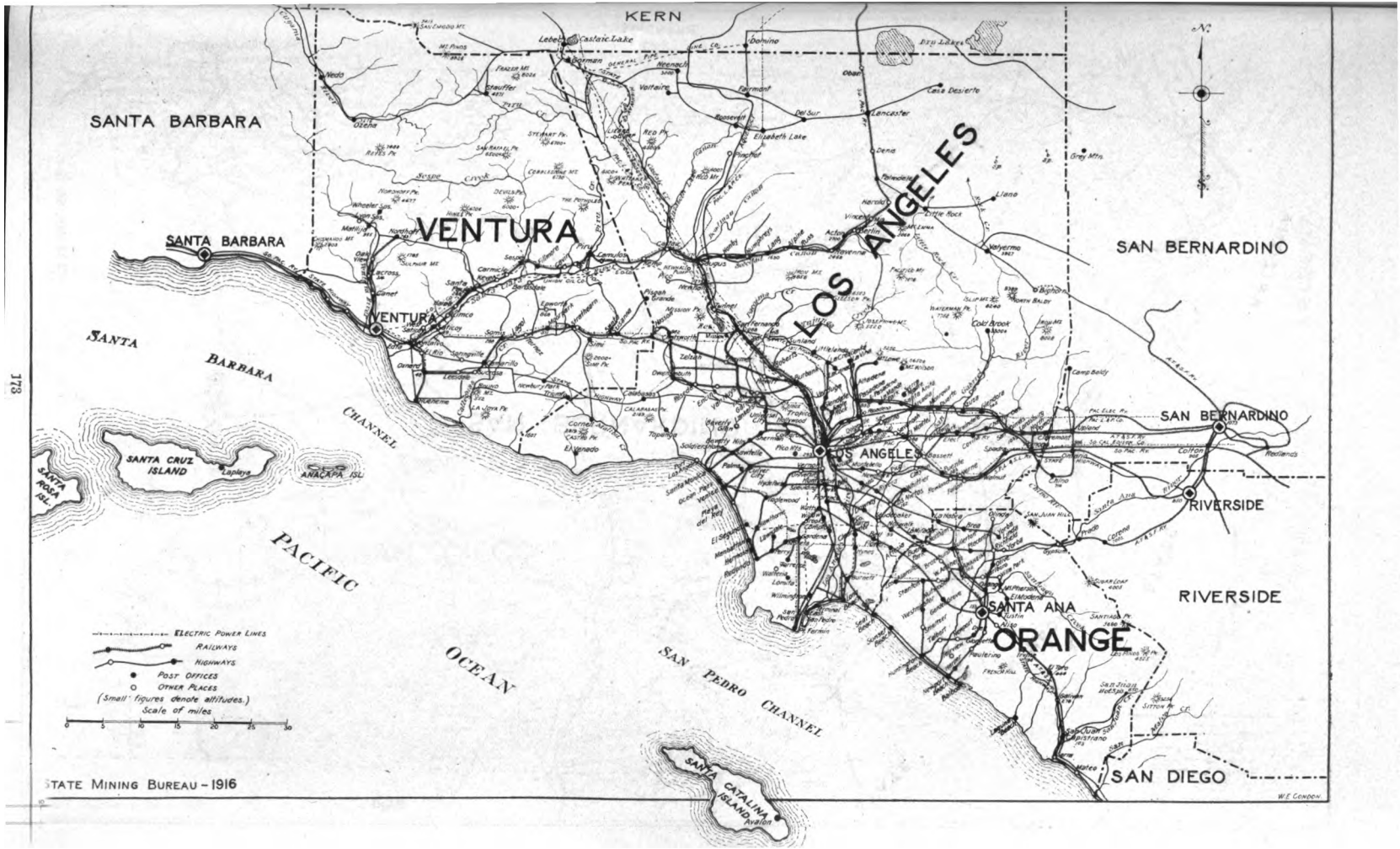

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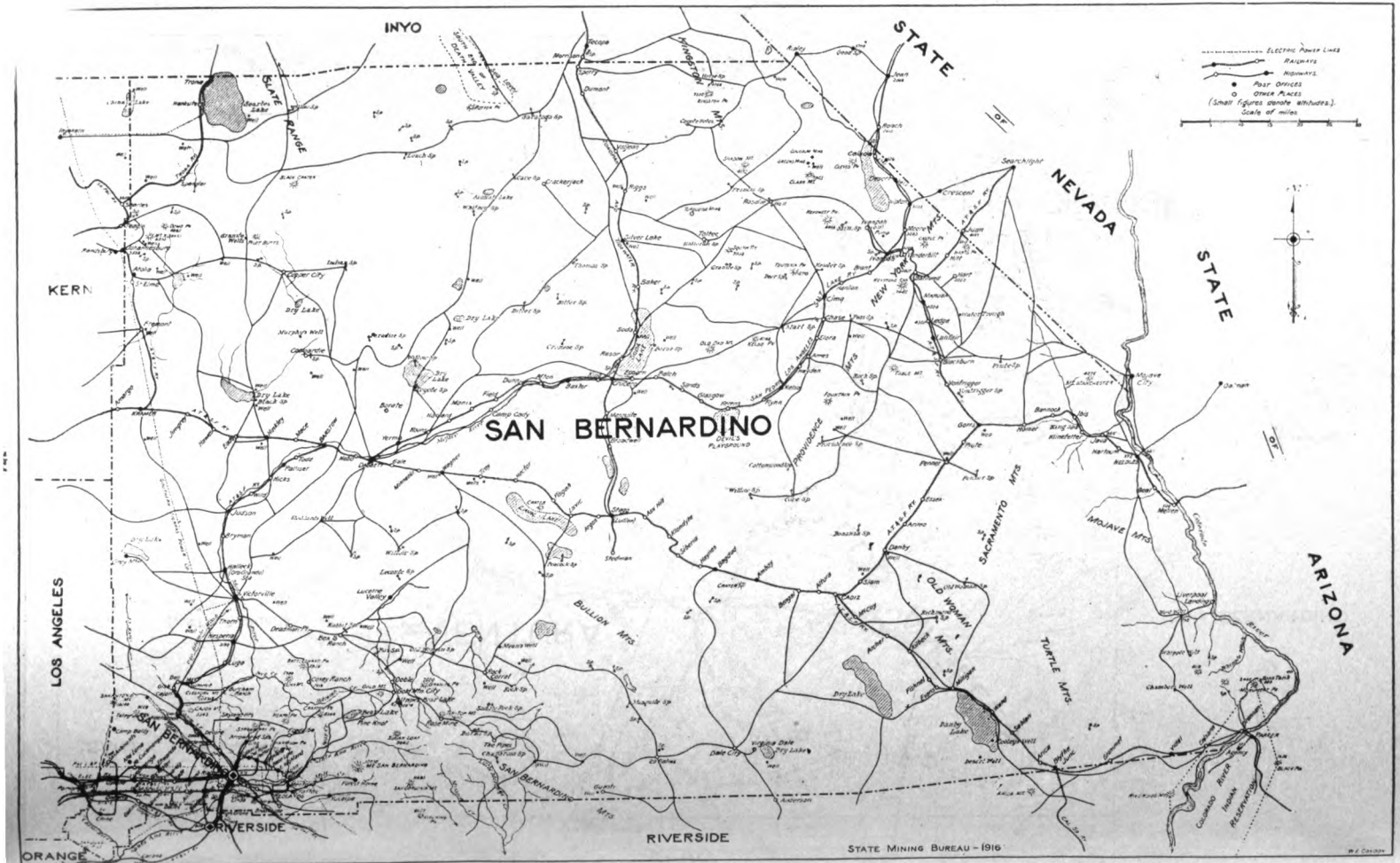

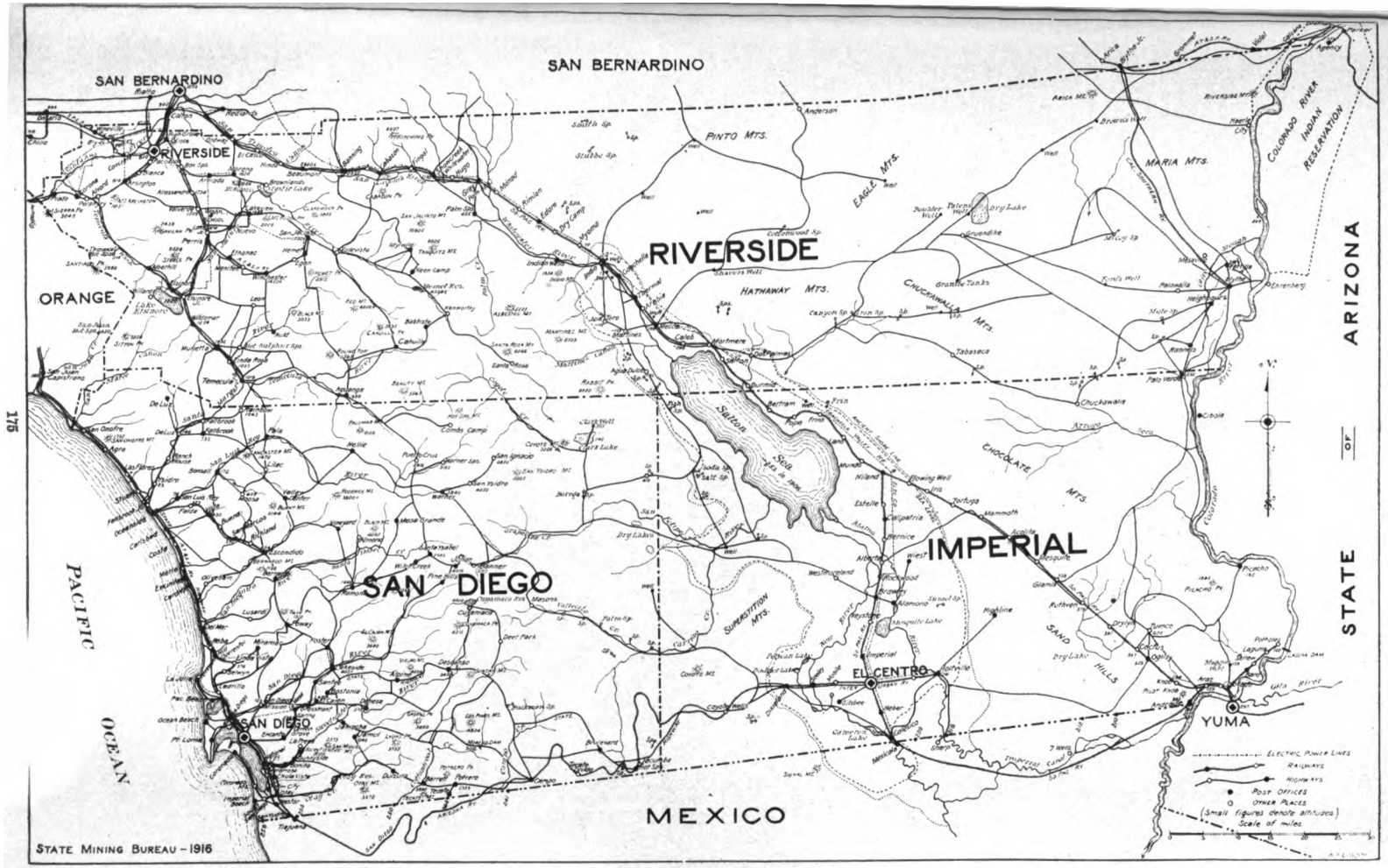

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